A COMPREHENSIVE STUDY ON ASHRUVAHA SROTO SHAREERA WITH SPECIAL REFERENCE TO SRAVA

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Submitted By

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Annexure III

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Undertaking

I **Vd. Gururaj D Jahagirdar**, is the Ph. D Scholar of the Tilak Maharashtra Vidyapeeth in **Rachana Shareera** subject. Thesis entitled **"A Comprehensive Study on Ashruvaha Sroto Shareera with Special Reference to Srava"** under the supervision of **Dr. Atul S Mankar,** Solemnly affirm that the thesis submitted by me is my own work. I have not copied it from any source. I have gone through extensive review of literature of the related published / unpublished research works and the use of such references made has been acknowledged in my thesis. The title and the content of research is original. I understand that, in case of any complaint especially plagiarism, regarding my Ph.D. research from any party, I have to go through the enquiry procedure as decided by the Vidyapeeth at any point of time. I understand that, if my Ph.D. thesis (or part of it) is found duplicate at any point of time, my research degree will be withdrawn and in such circumstances, I will be solely responsible and liable for any consequences arises thereby. I will not hold the TMV, Pune responsible and liable in any case. I have signed the above undertaking after reading carefully and knowing all the aspects therein.

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Annexure IV

CERTIFICATE OF THE SUPERVISOR

It is certified that work entitled **"A Comprehensive Study on Ashruvaha Sroto Shareera with Special Reference to Srava"** is an original research work done by **Vd.Gururaj D Jahagirdar** under my supervision for the degree of Doctor of Philosophy in **Rachana Shareera** to be awarded by Tilak Maharashtra Vidyapeeth, Pune.

To best of my knowledge this thesis

- embodies the work of candidate himself/herself
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- fulfils the requirement of the ordinance related to Ph. D. degree of the TMV
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Signature of the Supervisor

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CONTENTS

LIST OF TABLES

LIST OF GRAPHS

LIST OF FIGURES

17.	Specimens used in the cadaveric dissection
18.	Research scholar in dissection procedures.
19.	Clinical observational study – Eye examination
20.	Clinical observational study – Probing in lacrimal puncta

ANNEXURE

Annexure Number	Particulars
ANNEXURE I	Proforma for list of screened participants
ANNEXURE II	Proforma of screening form
ANNEXURE III	Patient information sheet
ANNEXURE IV	Patient consent form
ANNEXURE V	Clinical observation study - case proforma
ANNEXURE VI	Cadaveric dissection proforma
ANNEXURE VII	Codes used in Masterchart
ANNEXURE VIII	Master Chart –Clinical observation study
ANNEXURE IX	Master Chart - Cadaveric dissection study
ANNEXURE X	IEC letter

- AH – Ashtanga Hrudaya
- AS-Astanga Sangraha
- Cha - Charaka Samhita
- Chi – Chikitsa Sthana
- Dal – Dalhana
- Ni – Nidana Sthana
- Su S – Saushruta samhita
- Sha – Sharngdhara Samhita
- Su – Sutra Sthana
- Sha. Shareera sthana
- Ut – Uttara tantra
- Vi – Vimana sthana

ABSTRACT

Ashruvaha srotas is one of the anukta srotas, references regarding this are found to be scattered in the classics. Acharya Charaka has explained the basic concept of srotas in detail. As this aspect still remains unexplored, detailed exploration and research is required in this aspect. In classics separate ashru conducting strotas is not mentioned, but there are some indirect references are found. These are needed to be focused in structural and functional point of view. Hence one can understand the reason for various kinds of netra srava mentioned in classics. Therefore there is need for such studies which can define all aspects of Ashruvaha strotas. This study was undertaken to review the anatomy of the Ashruvaha srotas with respect to the lacrimal apparatus and drainage parts and to measure the distances of surgically important landmarks by cadaveric dissection. The next step of the study focused on the clinical observational study of the srava diseases which mainly involves the Ashruvaha srotas.

Aim: To carry out Comprehensive Study on Ashruvaha Sroto Shareera with Special reference to Srava

Material and methods:

- Conceptual study of Ashruvaha Sroto Shareera along with Netra shareera.
- Eye dissection on five cadavers and to determine the structures related to Ashruvaha Srotas.
- Clinical observational study on cases having Netra srava.

Conclusion

- **Cadaveric Study-** The landmarks of clinical importance are defined as
    - Ashru utpatti – Ashru Granthi (Lacrimal gland)
    - Ashrumarga (Storage and drainage system)- Ashruprapika (Lacrimal canialiculi, Ashrujavanika (Tear film), Ashrudwara (lacrimal puncta), Ashrukumbika (Lacrimal sac) Ashrukulya (Nasolacrimal duct)
- **Clinical observational study**-from this study it can be concluded that the Anatomical structures of Clinical significance (with respect to pathology) are,
    - Atipravrutti- Lacrimal gland (Ashrugranthi), Punctum (Ashrudwarasanjnaya)
    - Sanga – nasolacrimal Duct,punctum
    - Siranam Granthi – lacrimal Sac+ Duct
    - Vimarga Gamana – Nasolacrimal Duct

INTRODUCTION

Srotas is a channelized system responsible for carrying the fundamental bio-elements like Dosha, Dhatu and Mala. Srotas is involved in synthesis, transformation and transportation of bio-elements. These are thirteen in number according to Charaka and 11pairs according to Sushruta. Netra is one among the nine external openings (Bahirmukha strotas) of the body and very closely related to the process of lacrimation.

Ashruvaha srotas is one of the anukta srotas, references' regarding this is found to be scattered in the classics. Acharya Charaka has explained the basic concept of srotas in detail. As this aspect still remains unexplored, detailed exploration and research is required.

There is no description of particular mulasthana, dusti laxana of this srotas, which could help the academician of shareera and also physician to understand about the pathogenesis, diagnosis and treatment of Ashruvaha Srotas. There are some terms like Ashrumarga and netra nadi described by Susrutha samhitha uttaratantra, there is need to define and understand these words in terms of structural entities and to explore their relation with the Ashruvaha srotas. In Sushruta Uttaratantra 10^{th} adhyaya there is a reference related Jalavahini sira which is going to vitiate and produces ashrusrava. When we look at all the above mentioned terms we find that still there is need for standardization of these terminologies with respect to the structures.

Charakacharya in Navegandharaniya adhyaya of Sutrasthasna has mentioned the diseases caused due to obstruction of Ashruvaha Srotas. These disorders caused due to obstruction of Ashruvaha Srotas are been mentioned in Udavarta pratishedha adhyaya in Uttartantra of Acharya Sushruta.

In Netrarogas, there are several disorders are explained where Ashrumarga is involved, that is Ashruvaha Srotas. These diseases are caused due to vitiation of Ashruvaha Srotas. Netra srarva is one of the eye diseases where dosha enter the netra sandhi through the Ashrumarga and they cause secretion through kaninika sandhi. Netra sravas are classified into four types based on nature of the discharge.

However in classics separate ashru conducting srotas is not mentioned, but there are some indirect references are found. These are needed to be focused in structural and functional point of view. Hence one can understand the reason for various kinds of netra srava mentioned in classics. Therefore there is need for such studies which can define all aspects of ashruvaha srotas.

In the Modern anatomy there is separate description of lacrimal apparatus which comprises multiple structures. The comprehensive knowledge of surgeons in regard to of anatomical entities and structures is fundamental to the successful performance of clinical procedures like dacryocystorhinostomy. The recognition of the anatomical relationship between the lacrimal apparatus structures in relation to the various types of srava and clinical observations enables an easier clinical diagnosis and treatment and also helps to obtain more reliable results.

This study was undertaken to review the anatomy of the Ashruvaha srotas with respect to the lacrimal apparatus and drainage parts and to measure the distances of surgically important landmarks by cadaveric dissection. The next step of the study focuses on the clinical observational study of the srava diseases which mainly involves the Ashruvaha srotas. An effort is made here to correlate and interpret the clinically important anatomical structures and landmarks that are involved diagnosis and treatment of the srava diseases of Ashruvaha srotas well as defining the terms related to Ashruvaha srotas.

Aim and Objectives

Aim

A Comprehensive Study on Ashruvaha Sroto Shareera with Special Reference to Srava

Objectives

1. To compile and carryout the conceptual study of Ashruvaha Sroto Shareera along with Netra shareera.
2. To conduct Eye dissection on five cadavers and to determine the structures related to Ashruvaha Srotas.
3. To conduct clinical observational study on cases having Netra srava

Research Question

1. Is it possible to define terms related to Ashruvaha Srotas by the Cadaveric?
2. Is it possible to define terms related to Ashruvaha Srotas by clinical observational study?
3. Whether Ashruvaha srotas can be studied more precisely and define related terms with help of cadaveric and clinical observational study?

Hypothesis

H_1: Structures related to Ashruvaha Srotas can be defined by Cadaveric study and Clinical observational study

H_0: Structures related to Ashruvaha Srotas cannot be defined by Cadaveric study and Clinical observational study

Previous work done

1. Dr.Vivek Vasantrao Kulkarni, "Study of anukta Srotas w.s.r. To Ashruvaha srotas." 2008 thesis submitted to RGUHS, Bangaluru.
   In this study only literary study had been done from classics.
2. Vd Virendra G Ghodke, "Study on Asruvaha srotas with special reference to Jalasrava" Tilak College of Ayurveda and Research centre , Pune
   In this study jalasrava description is made.

Review of literature is comprised in following headings,

1. Srotas
2. Netra Shareera
3. Netra Roga and Srava vyadhi

Historical Background of Srotas

Rigveda

We will not find any direct and distinctly regarding srotas in Rigveda but there are some availability of examples related. Such as Sira, skanda, Phuphusa, hridaya therefore it is understood that, to expel the doshas from the respective places, there must be channels i.e. Srotas.

Yajurveda

We find ample of reference regarding srotas,

- The literature is available in sutra, Brahmana Guhya surtra and in Niruktas.
- Even in Gita also the relative definition regarding srotas is available i.e. Navadwaras.

Samaveda

Words such as srotas, Guha dwaara, Sravanti are available.

Atharvaveda

The word 'Srotas' is used in various manners at different places. They are referred as 'Marga' (path) and synonyms like Dhamanyah, Srothah, Hira, Panthan, Nidhi or Khani- Usually they are predominated by Akasha Mahabhuta, having the space in them can be considered as srotas.

Relatively more references are available in Atharveda regarding srotas. Some words reveal to srotas viz. Antra or Gavinya-reveal the two srotas as Annavaha and mutravaha respectively[1].

The word 'Srotya' directly gives the idea of flow in the Srotas or channels, the God has created seven openings (Saptakhani) in the head of human beings –such as ears, eyes, two nostrils & mouth respectively which equally co-inside with description of Bahirmukha Srotases of Ayurveda- in addition to the above[2].

Etymology

The word Srotas is derived from the root "*Sru Gatam*" by applying the Unidisutra "*Srutibhyam Tat Cha*" Shabdakalpadruma. (4/201) which means a passage through

which something can move. At the same time, the word has also been derived from the root "*Sru Sravane*" meaning to erude, to ooze, to fitter; to permeate. The natural oozing process of water is also termed as Srotas[3].

Sravathi Srotamisi

The meaning of the word Srotas is those structures in the body which have hollow space in them and helps in transportation of body fluids from on place to other is called srotas.

Srotas consist of two terms one is स्रु and another is तसिल् .The fundamental meaning of स्रु is to flow and तसिल् is to cause displacement and because तसिल् works like a pratyaya of ablative case it indicates, going away from here. Therefore srotas literally means a departing flow.

Amarkosh has given the description "स्रोतोम्बु सरणं स्वतः"

Definition

Acharya Charaka defines Srotas as "*sravanat srotansi*"[4]. While Chakrapani commenting on the same told that sravan means sravan of rasaadi dhatu's poshakasya or nutrient factor, that means srotas are the place from where the factors nourishing to the body or tissue flows.

In sutrasthana Charakacharya told that srotas are Ayana mukha for mala and tracts for movement of prasadansha and malaansha of dhatu[5].

Some acharyas opeines, Purusha or a body is the combination of several different kinds of srotas because they are spread all over body, i.e. sarvagatatvat, they flow all over body. But acharya Charaka had told that this interpretation is wrong because strotases are different on the basis of the material that they carries i.e. rasaadi dhatu etc, material by which they are built i.e. ghatitani, places they are situated i.e.mamsadau smabhadhani[6].

In Dhamanivyakaran shareeram acharya had told that srotas are the avakasha which is spread all over body through their mulasthanas and they are different from sira and dhamani[7].

In **Ashtangsangarah,** shareera sthana after describing the bahirmukh srotas acharya had told that *aantarani* i.e. abhyantar srotas are the *jivitayatanani*. While

commenting on the same Shashilekha tikakar told that pranadi srotas are *jivitasya sthanani* and these are the path or tracts of these pranadi dhatu[8].

Bhavamishra stated that srotas are the tract or marga through which mana, prana, paneeya, dosha, dhatu, mala, upadhatu etc. sancharati or circulate. These srotas are innumerable in number that's why they called Asankhya[9].

Sushrutacharya in shareera sthana told that srotas are of two types, bahya and abhyantar, bahya srotas are karna, nayan, mukha, etc and abhyantar are those explained in Dhamanivyakaran shareeram, here Sushrutacharya understood srotas as chidra or hole whether they are bahya or abhyantar i.e. bahirmukh or antrmukhi srotas[10].

Synonyms [11]

- Sira (vein),
- Dhamani (artery),
- Rasayani (lymphatic ducts),
- Rasavahini (capillary),
- Nadi (tubular conduits),
- Panthana (passages),
- Marga (pathways, tracts),
- Sharirachidra (body orifices),
- Samvritasamritani (open or blind passages),
- Sthana (sites),
- Ashaya (repertories),
- Niketa (resorts)

Utpatti of srotas

In the embryonic development prakrut vayu along with Ushna guna of pitta by making the cavity forms the srotas[12].

While describing the function of vayu in Vatakalakaliya adhyaya also acharya have mentioned the same[13].

Swaroopa of srotas[14]

After knowing definition, to understand the concept of srotas, one has to know swaroopa of srotas. In ancient era acharyas were used similes for better understanding the concepts. Charaka acharya in Srotovimaniya adhya has explained the samanya swaroopa and laxana of srotas.

1. Sthula – (*gross or macroscopic*) Even though gross, some of these srotas by virtue of their location in the body e.g. being annavaha and purishavaha srotases (combindly known as koshtha) may not be visible unless the body is cut opened by dissection.
2. Anu or sukshma – (*subtle or microscopic*). These cannot be visualized easily. The microscopic or macroscopic nature of the srotas is dependent upon the qualities and quantity of the substance being transported by it. The quantity is based on the requirement of the organ supplied by that srotas.
3. Usually all srotases are round/tubular. The srotases conveying the corporeal dhatus and other materials are tubular, whereas the srotases carrying the incorporeal vata may be solid and microscopic.
4. The length of the srotas is determined by the distance between various organs and/or tissues connected by the respective srotases for the supply of the necessary substances.
5. According to the area of the body through which a srotas is traversing, it may be in the shape of a net i.e. reticular shape as per the reqirment.
6. The srotases carrying the dhatus get the colour of the respective dhatu.
7. The walls of the dhamanis contain microscopic strotases or pores allowing the rasa to permeate throughout the body.
8. These srotas are just like pratans or like climbers

Ayurveda accepts the *"pindi te brahmandi nyaya"* according to that acharya has explained like rivers in the world or on the earth which carries water; srotas are just like river in the human body which carries srava from one place or tissue to another. At some place in samhitas we also come to know that acharya have mentioned that srotas are just like network of vessels on the surface of leaves and also srotas are the hollowtube in the stem of Lotus[15].

In Jwara nidana of Ashtangsangarah while describing the samprapti of Vishama jwara vrudhha vagbhat mentioned that due to sukshmata and durata of uttarottar srotas kala of jwara is visham[16].

Commenting on same Indu clearly told that srotas *are pratan sadrushani,* their mula i.e. starting point of opening are sthula or broad and their proceeding end or openings are small or microscopic. Comparison between rasaadi srotas, uttarottar

srotas are long or far away. In Ashtanghriday jwar nidana in same context we get the reference that opening of rasvah srotas is sthula and vivrutta means broad, while the openings of uttarottar raktadi srotas are samvrutta and sukshma means smaller or microscopic.

Sira-Dhamani-Srotas

To understand the concept of srotas we must go through in detail with terms Sira-Dhamani-Srotas thoroughly. We always get confusion with these three words. In our samhitas at some places these words are used as synonyms and elsewhere they are said to be different from each other. So it is very difficult to come to the conclusion about it.

Atreyacharya in sutrasthana clearly mentioned that *dhmanat dhamanya* means dhamani are the structure where pulsation is being felt. Chakrapani commenting on same wrote that, dhamani are the tubular structure which are filled with full of rasadi dhatu. *Saranat sira* means, sira are the structure from where substance flows from one place to another. *Sravanat srotas* means from where oozing or transportation of poshya dhatu take place[17].

According to some acharya dhamani srotas are the same but in Dhamanivyakaran shareera acharya Dhananvantari has not accepted it. On the basis of *vyanjananyatvat*, *moolasanniyamat*, *karmavaishamyat* and *agamat* acharya told that sira dhamani srotas are different, but still confusion prevailed as they are one and same because they are very nearer to each other, doing same type of work and arevery microscopicin size[18].

In Nibandhasangarah, acharya Dalhana while commenting on same told that sira dhamani srotas are same because they all are formed from sira vikaras that means as the curd and buttermilk are the milk vikaras i.e.by products of milk, sira dhamani srotas are sira vikaras i.e. by product of sira. Dalhanacharya also mentioned quotation without its reference that all the akashiya avakashas in human body can be called as Sira, srotas, Marga, kha, Dhamani, Nadya and Ashaya. In same context he also told that Vyanjanatvat means colors of vatavahadi sira are Arun, neela, shukla and lohit. Colors of srotas are as colors of poshak dhatu. Mulasanniyamatvat means there are forty mulasira, twenty four dhamani and twenty two for srotas. Karmavaishamyat means functions of each sira dhamani srotas are different, as functions of sira are

apratighat etc. as mentioned in Sushrut shareera sthan 7th adhyaya, 8th to 15th shloka, functions of dhamani are shabda rupa rasaadi vahanam and functions of srotas are prana-anna-shonit-udakadi vahivtam i.e. carrying. Agamat means at various places acharya used sira dhamani srotas these three words in one sentence. If these are same then acharya might have understood any one of them but it is not so seen as per su.sha.5/5 and su.su.5.

As all of them are arranged so closely that it is very difficult to differentiate between them, here we may get confused and get an impression that all of them are one and perform same function, just like when bundle of dry grass is burning at that time each single stick of grass is burning separately at a time but we think that grass is burning. For rectification of this same fact Dalhanacharya have given two more examples as singer with co-singers singing a song, looks like they are singing song in one voice but each of them are singing separately and they are having their own separate voice and as water dribbling from pot but water is oozing out of pours present in each particle of mud which give us impression that water is dropping from mud pot.

In Charak samhita vimana sthana acharya has mentioned some terms which are indicative of srotas, these are as Srotas, siraha, dhamanyaha, rasanyaha, rasavahinyaha, nadyaha, panthanaha, margaha, Shareera chhidrani, sthanani, ashayaha, niketaha at the end he has mentioned that all avakash present inshareera and dhatu are to be called as Srotas. At the end of adhyaya he has clearly told that these are nama paryayaha which means the terms which come nearer to srotas[19].

From this also it is clear that sira dhamani srotas are not exact alternative for each other or theynot one and the same.

While describing the vividha sthana gata shalya laxanas in sutrasthana acharya Sushruta had told that when shalya goes in the srotas it will cause the loss of function and loss of characteristics of srotas. Dalhanacharya commenting on the same has explained that loss of function means rasaadi vahanam, gunas (i.e. characteristics) vatadivahanam(srotasam) varna rhasa i.e. the loss of arun, peeta, sit, rakta etc. which arecolors of vatadivahasrotas[20].

In sutrasthana last adhyaya acharya used word the "*srotasya annavahe"*, while Dalhan explained it as Amashaya. Means srotas word is used for Ashaya also.

Classification according to different Acharyas

In our classics we get different different number and types of srotas. Acharya Charaka had given opinion about srotas on the basis of chikitsa or physiology for understanding the chikitsa of diseases where acharya sushruta had explained srotas on the basis of shalya or surgery. Hence both have explained srotas in different to get the concept of srotas we have to see the description of srotas in both aspect.

Both acharya told that, basically the srotas are of two types that are bahya srotas and abhyantar srotas. Bahya srotas are nine in number according to sushruta[21]. And these bahya srotas are called as bahya chhidra by charakacharya[22.]

These nine are,

- karna -2
- Nayan-2
- Vadan -1
- Ghrana-2
- Gguda-1
- Medra-1

All acharya had told the same opinion.

Number of Abhyantar Srotas is not confirmed by Acharyas. All acharayas had different opinion about number of abhyantara srotas. Some acharya told that number of abhyantara is not to be confirmed because they are not countable. Some acharya told the number of srotas that are according to Charak srotas are thirteen in number. According to Sushrutacharya numbers of srotas are eleven pairs. Vagbhatacharya had followed the charak's opinion.

Table no.1: Name of Srotas according to various authors

Sr.No.	Name of srotas	Charaka[23]	Sushruta[24]	Vagbhata[25]
1.	Pranavah	✓	✓	✓
2.	Annavah	✓	✓	✓
3.	Udakvah	✓	✓	✓
4.	Rasavah	✓	✓	✓
5.	Raktavah	✓	✓	✓
6.	Mansavah	✓	✓	✓
7.	Medovah	✓	✓	✓
8.	Asthivah	✓	×	✓
9.	Majjavah	✓	×	✓
10.	Shukravah	✓	✓	✓

11.	Purishavah	✓	✓	✓
12.	Mutravah	✓	✓	✓
13.	Swedavah	✓	×	✓
14.	Artavavah	×	✓	×

Concept of Mulasthanas

As we have discussed the definition of srotas then we came to know that to know the whole concept of srotas, concept of mulasthanas is also being studied thoroughly. The mulasthanas are very important for the diagnosis, describing the samprapti and for fixing the line of treatment. Acharya had described mulasthanas of different srotas according to that srotas, so to understand the concept of mulasthanas completely, one have to study each srotas with its mulasthanas separately.

Commenting on the word srotomula acharya chakrapani has used the word *Prabhavasthana* of the srotas. In sushrut also acharya had explained the srotas and its srotoviddha laxanas according to their mulasthanas only. Dalhanacharya while commenting on same told that mulasthanas are the places from where the dhatu or substance flows the like hrudayadi holes or internal holes.

Table no.2: Mulasthanas of different srotas according to Acharayas

Name of the srotas	**Charaka**[26]	**Sushruta**[27]
Prana vaha	Hrudaya and mahasrotas	Hrudaya and rasavahidamani
Annaraha	Amashya vama parshwa	Amashaya and annavaha dhamani
Udakavaha	Talu, kloma	Talu,kloma
Rasvaha	Hrudaya and dashadhamani	Hrudaya and rasavahi dhamani
Raktavaha	Yakrut, pleeha	Yakrut, pleeha
Mamsavaah	Snayu and twachi	Snayu, twacha and raktavaha
Medovaha	Vrukka vapavahana	Vrukka kati
Astivaha	Meda and jagana	---------
Majjavaha	Asthi and saudhi	----------
Shukravaha	Vrushana and sneha	Vrushana and stana
Swedavaha	Meda and lomakupas	---------
Purishavaha	Pakwashaya sthulantra and	Pakwashya and guda
Mutravaha	Basti and vankshana	Basti and medra
Artava vaha	-----	Garbhashya artvavaha dhamanya

Functions of srotas

1. To serve as conduits through which both prasadakhya (nutrients) and malakhya dhatus (waste products or products of degradation) are transported.
2. As structures through the pores of which prasada dhatus or malas pass to and from the sthayi dhatus.

The srotases serve as to channel of transport for the dhatus undergoing transformation to their destination.

Every cell in the body requires nourishments thereby necessitating the spread of srotases up to the cell. This fact justifies the statement of some authorities that the body is a conglomeration of srotases.

The srotases are also the transporters of factors that cause the vitiation or alleviation of the doshas.

In other words, the foods and drinks which are not healthful and capable of vitiating the doshas and the medicines which bring about the equilibrium of the doshas also circulate through the srotases.

Srotodusti or sroto viddha laxanas

In view of the importance of the above stated functions of the srotases, it is imperative that every physician should thoroughly understand the signs and symptoms produced by the vitiation these srotases. Therefore Atreya had advocated the physician's need to recognize the origin, course, signs and symptoms exhibited by their pathological involvement and the treatments there of the more gross srotases

There seems to be a difference of opinion between Charaka and Susruta on this subject. Justifying the difference, Dalhana observes the special kinds of pain exhibited in cases of the pathological involvement of srotases are important from the point of view of Kayachikitsa. In shalyalantra, on the other hand, the pains of special kinds which may manifest on account of either the piercing of or injury to srotases present in certain special parts of the body are important. To gain knowledge of the prognosis of such conditions. In contrast, Kayachikitsa recognizes srotases which are spread throughout the body and which include extremely tiny ones. Any pathological involvement of them may manifest subtle kinds of pains which may not be recognized or be of help in the assessment of prognosis in such involvements.

In charaka vimansthana fifth adhyaya acharya had told the sroto dushti laxanas along with their causes also. Dushti laxanas of some srotas are explained in sutrasthana[28].

Table no.3: Sroto dushti laxanas and their causes

Name of the srotas	**Dushti Hetu**	**Dushi laxanas**
Prana vaha	Kshayat, vegadharanat, vyayamat, kshudhitat	Atisrushta atibaddha kupita alpa alpa continuous or with pain breathing.
Annavaha	Atimatrashana, Akala, Ahitashanam, Agni dushanat.	Anannabhilasha, arochak, Avipak, chhardi.
Udakavaha	Aushnyat, Amat,Bhayat, Atishushkanna sevanat, Trushna pidanat	Jivha-Talu-Ostha-Kantha-kloma – shosham, Ati pipasa.
Rasvaha	Guru-Sheeta-atisnigdha-atimatra samashnatat, Chintanat	Ashraddha, aruchi, alasya vairasya, Arasadnyata etc. Rasa pradoshaj vichar.
Raktavaha	Vidahi anna-pana, Snigdha-ushna dravya, Atapa sevanat	Kushtha, Visarpa, Raktapitta, Gulma, Raktapradoshaj vikaras.
Mamsavaah	Abhishandi-Guru-Sthula ahara sevan, bhuktva swapna, Divaswapna.	Adhimansa, Arbuada, kila, Alajee, Gandamala, Upajivhika etc mamspradoshaja vicar.
Medovaha	Avyayam, Divaswapna, Medyanam atibhakshanat, varuniatisevan	Prameha purvaroopa ,Shtaulya.
Astivaha	Vyayamat, atisankshobhat, vatalaanam sevanat	Adhiasthi, adhidanta, danta-asthishula, vivarnata, keaha-Loma-Nakha-Smashru dosha.
Majjavaha	Viruddha sevanat, ati-abhshyandat, abhghatat, prapidanat	Parvanam ruka, Bhrama, murchha, Tamadarshana,Arunshi, Parvajanam darshanam.
Shukravaha	Akala, ayoni ati – maithuna, shykravegavarodha, Shasrta Kshara, agni.	Klaibya, Aharshanam, Garbhprasvravan, Apatyabadha
Swedavaha	Vyayamat, Atisantapat, Sheetoshna karma sevanat, krodh shok bhsayat	Aswedanam, Atiswedanam, Parushyam, Atishlakshnata, Paridaha, Lomaharsha.
Purishavaha	Vega sandharanat, Atyashana, ajirnashana, adhyashana, Durbalagni, Krushata	Kruchrena alpa-lpam, sashulam,atidravam,atigrathitam, malapravrutti.

Mutravaha	Mutrit udak sevanat, stree sevanat,mutra nigrahat, Abhkshatat	Atisamsrushtam, Atibadhdam, prakupitam, Alpalp abhkshanam, bahalam, sashulam Mutra pravrutti.

Table no.4: Viddha laxanas[29] of the srotas according to Sushrutacharya.

Sr.No.	**Srotas**	**Viddhalaxanas**
1.	Pranavaha	Akrosh, vinaman, Mohana, Bhramanam, Vepan and Marana.
2.	Annavaha	Adhmana, Shoola, Annadvesh, chardi, pipasa, And Aandhya
3.	Udakavaha	Pipasa, Marana.
4.	Rasavaha	Shosha, Pranavaha Sroto viddhavat, Maranam
5.	Raktavaha	Shyavangata, Jwara, Padu, daha, Shonitagamana and Raktanetrata
6.	Mansavaha	Shvayathu, Mansashosha, Sira-Granthi, Marana
7.	Medovaha	Swedagamanam, Snigdhangata, Talushosha, Sthulashofata, Pipasa.
8.	Mootravaha	Aanaddha bastita, Mootranirodha, Stabdhamedhrata.
9.	Poorishavaha	Anaha, Durgandhyata, grthitantrata
10.	Shukravaha	Klibata, Chirat praseka, Raktashukrata,
11.	Artavavaha	Vandhatvam, Maithunasahishnutvam, Artava nashasya.

Shalakya tantra is one of the important aspects of ayurveda which deals with the treatment of diseases associated with upper body parts (above the neck). The Shalakya tantra describes detail account on causes, diagnosis and treatment approaches of the diseases related to the ear, nose, eye and throat. The basic concept of shalakya tantra lies around the use of shalakas (probes) for applying medication to the upper body parts. The shalakas used to treat eye disease termed as netra shalaka, the shalakas used for the ear treatment termed as karna shalaka while nasa shalaka and mukh shalaka used for the treatment of nose and throat.

Evolution of Ophthalmology in Ayurveda

In Vedic Period

The task of tracing back the history of shalakya tantra has been very difficult, as early history of it is quite obscure. The 'Shalakins' as a class of specialist were developed in the course of vedic period (8000BC). In Vedic period, Rigveda the oldest treatise of the world there is mentioned of the revival of the lost eye-sight by the great

physicians of that time like, Asvinikumaras and the lord Indra. It stands as an evidence of first medical Knowledge and treatment of the eye diseases of which can record in history of human race. Atharvaveda, is the chief source of origin of Ayurveda, gives better advanced medical knowledge. We find in Kensutra of Ayurveda, the description of sense organs with their proper systemic location, specially the eye ball in the skull over the vertebrae of the neck etc. Besides this we also find the description of valuable drugs has been applied for the improvement of eye-sight and cured the congestion of the eye (the cardinal signs of Abhishyanda).

In Samhita Period

The history of shalakya tantra appears to be as old as that of Ayurveda. The shalakya has got priority in both of the authentic classical treatise i.e. charaka and susruta samhita. Both these texts established the fact that during, their times Shalakya had evolved itself as one of the important branch of the healing art. It illustrates the fact that Shalakya had become popular science even during pre-historic period. Dalhana (12th Century AD) the pioneer commentator of Susruta Samhita defines that Shalakya is the science and art where instruments used are chiefly rod in shape, it belongs to the section of head and neck disease. There were specialists of Shalakya who were called 'Shalakins' and the specialists of eye diseases were known as 'Dristivisharada'[27].

Sushruta and Opthalmology

In first century A.D. it was noted that while western Scholars made some headway in Shalakya tantra, Indian Scholars had already done as much or more about 1000 years back and the perfection they had reached was for ahead of the excellence attained by the Greece – Romans one thousand years later. Several Ayurvedic Scholars had specialized in Shalakya tantra and has composed many treatises where as during the same period the Greek had not apparently developed such specialties. Sushruta was called '*the father of Indian surgery*' during the Vedic age which is well before the Hippocratic period and he sites several western scholars who consider India the birth place of medicine. According to Johnson saint, the present of modern medicine is not Greece but India. Sushurata knew ocular anatomy, physiology, pathology and therapeutics of the eye. It stated that there are 76 varieties of ocular diseases and 51 out of them were surgical. He performed cataract surgery followed by lensectomy and lens extraction. He was the first ophthalmic surgeons who applied the snake venom

and fast for the prevention of cataract, lekhana Karma in trachoma with the leaves of Sephalika was Susrutas's special parasurgical contribution. In the field of Indian ophthalmology ocular therapeutics like Parisheka (spray), Swedana (fomentation), Anjana (collyrium or eye ointment), Aschyotana (eye drop), tarpana and Putapaka (chemotherapy), Sekam (eye wash) etc have been mentioned about 100 anjanas have been mentioned for treating ocular diseases, and their number gradually increases from time to time of Susruta and onwards. 'Kriyakalpa' is speciality of application of medicine in the eye diseases locally are unique techniques. Except Aschyotana, these Kriyakalpas probably have no corresponding equivalent in the modern ophthalmology. According to Susruta ordinary water is acidic in reaction; therefore he has advocated the use of distilled water (parisruta jala) in the treatment of abhisyanda especially for ocular clean.

NETRA SHAREERA AND KRIYA

"*Chakshurindriya*", occupies the key position among the other Jnanendriyas[30].

Vyutpati

- The term Chakshu is derived from the root '*chaksh*' denoting Darshna (sight) and Karana (organ responsible for sight) according to Vachaspatya[31].
- According to Shabdakalpadruma the word 'Chakshu' means Darshanendriya[32]

Nirukti

According to Charaka, Chakshu is one among Panchajnanendriyas, which is responsible for 'Roopagrahana'.Where as Sushrutha defines Chakshu as a Buddindriya originating from 'Rupatanmatra' performing visual perception with the dominance of 'Tejomahabhuta'[33].

Etymological Derivations

The meanings of each of the synonyms are as follows,

1. Akshi
    - According to Shabdakalpadruma - Akshi means it is a Source of reaching or seeing
    - Panini describes eye is the one of sensory organ and it is more glowing than the other parts of the body or organ.

- Akshi is derived from two word, As+Kshi: its meaning is grasps objects

2. Chakshu
    - In Vachaspatya Responsible for sight.
    - Accoding to Shabdakalpadruma -Darshanendriya.
    - Sir M.M. William dictonary - Eye, vision, faculty to see, Lord Shiva, name of Maruta, Sage, Sun etc.
    - Chakshin is the another term utilized for eye and its description is like this 'Chakshate yena Chakshu'
3. Drishti
    - It is a Source or tool by which one can see
    - If we see the review of literature regarding Drishti, it is having different meanings such as Netra, Drishti Mandala, Netrakriya (vision), Ateendriya, Darshana etc
4. Netra
    - Its menaing is like this, which takes towards knowledge.
5. Nayana
    - Its mening is like this, reaching objects with the its help.
6. Lochana
    - Shabdakalpadruma states lochana as tool with which one can see.
    - Amarkosha describes as; viewing capacity is by the lochana.

Netra Utpati

As per Charaka the development of the Indriyas begin during the third month of Garbhavakranti. According to Acharya Kashyapa eye is the first organ to develop in the fetus, but Punarvasu Atreya declares that all the sense organs develop simultaneously.

As per Sushrutha the subtle form of all the Indriyas are present during the formation of Garbha[34].

Ekadasha indriyas including Chakshurindriya are derived from the combination of Vaikarika Ahankara with the Sathwika Ahankara. All the indriyas become explicit during the third month[35].

Vagbhata attributes development of Indriyas to Kapha and Raktavaha Srotas. He details the embryological aspect of each part of the eye, for example Shukla Mandala

is developed from Kapha and it is said to be a Pitraja Bhava, Krishna Mandala from Rakta and a Matraja Bhava. Both these factors collectively form Dristhti Mandala[36].

Sushrutha describes the role of Panchamahabhuta in the development of various parts of the eyes. The muscular portion is derived from Prithvi, Rakta from Agni, Krishnabhaga from Vata, Shwetabhaga from Jala and Ashrumarga from Akashamahabhutas[37].

The colour of the eye is determined by the tridosha[38], when Teja associates with Rakta Dhatu results in Raktakshi (reddish eye) when same Tejas is associatied with Pitta forms Pingakshi (dark brown eyes) and if it associates with Kapha than causes Shuklaksha (pale eye), If Tejo Mahabhoota does not reach to Drishti part then child is born congenitally blind and when it associates with Vata causes Vikrutakshya.

Sushruta explains that, Netra is the Prasada bhaga of 'Majja'. Majja Dhatu is placed above Akshi. Any Sara/asara or Vriddhi/Kshaya of Majja Dhatu affects the Chakshurindriya. Hence Majja is Maha Netra. Therefore in case of Majja Vriddi the Gauravata in Akshi also increases and Bhrama is seen as because Tamadarshana can be seen in Majja Kshaya[39].

Paryaya

Shivashakti, Strimurti, Trikala, Linga, Mahajyothi (Netraprakashika), Lochana, Nayana, Darshana, Akshini, Drik, Drishti (Parishadya Shabdartha Vijnana)

Panchabhautika Composition:

Netra is composed of all the five Mahabhutas, ref- Su ut 1/11

1. Mamsa – Prithvi
2. Rakta- Agni
3. Krishna mandala- Vayu
4. Shewta mandala- Jala
5. Ashrumarga- Akasha

NETRA –SHAREERA

Realizing the importance of the eye, Sushruta has described the Anatomy of this organ in most elaborated and practical way while discussing various anatomical components in terms of their size, shape, and relation as is visible in a person.

Situation[40]

Head is the highest part of the human body, when compared to all other parts. It is the

site of life for living beings. All the senses are situated in and supported by the shira [41].

Two orbits are located in the head, which gives shelter for Netras, but these two netars are considered as one Chakshurindriya. The Netraguhas are among the nine external openings of the Body (Bahirmukha srotas) [42].

Shape[42]: The shape of the netra is explained in Sushruta Samhita Uttartantra as Suvrittam, Gostanakaram and Nayana Budbudam, which means the shape and consistency of the Netra.

1. Suvrittam: The shape of eyes is spherical in all directions.
2. Gostanakaram: It means teat of the cow (oval shaped). If we see eyeball with extra ocular muscles and optic nerve it looks similar to Cow's teat.
3. Nayana Budbudam: A bubble floating on the water. Eye is round in shape and soft in consistency and glossy / glistening in character, by these characteristic the word suggestive of external appearance of the eye in the orbit.

Dimensions of Netra[42]

The measurements of the eyeball as described by Acharya Sushruta in terms of 'Anguli pramana' - Swangushthodara i.e one's own thumb, commentator Dalhana also opeines the same. There are two dimensions – 2 Angulas Bahulya and 2 ½ Angulas Sarvata. According to some scholars, the word 'Bahulya' means anteroposterior diameter or thickness of the eyeball and it is 2 Angulas. The word 'Sarvatah' can be considred as the side-to-side measurement i.e. Circumference of the eyeball; and it is 2 ½ Angulas. If we see the detailed references, the exact measurement of 2 ½ Angulas is applicable to the side by side distance of the eye (the distance from inner to outer canthus). As per Dalhana, the word 'Dvyangulam Sardham' means 'Ardha Triteeyangula'. This was commented by some scholars as 3 ½ Angula and they consider it as the circumference of the eyeball.

Anatomical Parts of the Netra

Sushruta describes anatomy of the eye as 5 Mandalas, 6 Sandhis and 6 Patalas. We find same wordings in Vagbhatta, Madhavakara and Bhavamishra texts.

Mandala[43]

The root word Mandala is made from 'Mad' + 'Klach' pratyaya. Means, which covers in circular areas or appears as concentric circles. The five Mandalas of the eye are,

1. Pakshma Mandala: It is the first and outermost Mandala of the eye and is formed by the Pakshma (eyelashes).
2. Vartma Mandala: The two eyelids join and form a circle in front of the eyeball, which is called as Vartma Mandala.
3. Shukla Mandala: The part appears as whitish is known as Shukla Mandala. The Shukla Mandala can be correlated with sclera which is the outer fibrous coat of the eyeball.
4. Krishna Mandala. Cornea appears as krishan in color so it may be considered. The size of this Mandala is 1/3rd of the whole Netra.
5. Drishti Mandala: Innermost circular structure of the Netra encloses Drishti in it and hence named as Drishti Mandala. It is about 1/7th of Krishna Mandala. It is also equal to 1/9th part of the "Taraka".

Sandhis

Sandhis are the meeting point or Junctional Areas between two Mandalas. The Sandhis are 6 in number. They are,

1. Pakshma Vartma gata Sandhi: The meeting point or line of Pakshma Mandala and Vartma Mandala is called as the Pakshma Vartmagata Sandhi and it is considered as the lid margin.
2. Vartma Shukla gata Sandhi: The union line between Vartma and Shukla Mandala. It is considered as Fornix of the eyeball where the palpebral conjunctiva is reflected on to the bulbar conjunctiva.
3. Shukla Krishna gata Sandhi: The circular line joining between Shukla Mandala and Krishna Mandala is known as Shukla Krishnagata Sandhi. Sclero corneal junction is relevant structure according to description.
4. Krishna Drishti gata Sandhi: The union line of Krishna and Drishti Mandala is called as Krishna Drishtigata Sandhi. The central free margin of the iris, which rests on the anterior capsule of the lens, can be considered.
5. Kaneenika Sandhi[44]: Inner or nasal canthus of the eye.
6. Apanga Sandhi: Outer canthus of the eye.

Patalas

Patala is one of the structures told by Sushruta in Netra Shareera. Various authors have described and interpreted the concept of Patalas in their own way and yet no

consensus has reached upon among them on this subject. V.S. Apte, in his Sanskrit – English dictionary describes the meaning of Patala as a film or coating over the eyes.According to Monier Williams, it can be considered as a layer of the eyeball.

Etymology: Pat + "Klach" pratyaya- Which means a layer, veil, covering chest, membrane especially of the eyes, a film over the eyes. So it can be considered as the layers of the eyeball. There are 6 Patalas in the eyeball – 2 Vartma Patalas and 4 Akshi Patalas. The pathogenesis of Drishtigata Rogas, especially Timira has been described in terms of involvement of successive Patalas. The prognosis of the disease also depends upon the involvement of respective Patala. Sushruta considers different Akshi Patalas and their constituting factors are as follows[45].

- First patala is Tejaojalashrita
- Second one consists of Mamsaashrita,
- Third Patala is Medoashrita
- Fourth Patala is Asthyashrita

Their thickness is equal to one-fifth of the Drishti[36]. Dalhana has described the outermost Patala as "Tejojalashrita". Teja means Alochaka Pitta and so Siragata Rakta can be taken as Teja. Jala is considered as implies Rasa Dhatu. This Patala is the Ashraya for Rasa and Rakta Dhatus.

If we see modern references it can be correlated like this,

- 1st Patala - Cornea and Aqueous humour
- 2nd Patala -Iris and Ciliary body.
- 3rd Patala -Lens & Vitreous humour
- 4th Patala -Retina,

Sira and Dhamani:

There are 38 siras, out of which 8 siras carry vata, 10 pitta, 10 kapha and 10 rakta to the eye[46].

65 siras are present in the eye; among them two siras helps in opening and closing the eyes[47].

Total 4 dhamanis present out of it, 2 carrying rupa or visual impulses another 2 carry tears[48].

Peshi and snayu:

There are two muscles in the eye[49].

Two snayus are present in the eyes[50].

Asthi: Akshikosha or orbital cavity contains a tarunasthi[51].

Sandhi: There are two joints in the lids of the eye [52,53]

Marma

1. Apanga – 2 Apanga marmas, (it is Sira marma, measures about half angula pramana) are situated on the outer side of the orbits below the lateral end of eyebrows. Injury causes blindness or diminished vision[54].

2. Avartha – 2 avartha marmas (it is a Sandhi marma, measuring half angula pramana) lie above the eyebrows, injury causes blindness or diminished vision[55].

NETRA KRIYA SHAREERA

Chakshu is the visual sensual faculty ie one of the panchendriyas [56,57].

A mental faculty instantaneously manifested (in a particular form) as a result of proximity of the soul, sense faculties, mind and the objects is known as pratyaksha (percepition or direct observation)[58].

The sense faculties are capable of perceiving their respective objects, only when they are motivated by mind. In the process of jnanotpatti (Roopagrahana), the stages involved are,

1. Indriyartha Sannikarsha
2. Roopalochanam
3. Jnanotpatti

Of these stages, Indriyartha Sannikarsha involves vata mainly with little kapha. Roopalochanam involves pitta predominantly. Jnanotpatti involves vayu and pitta

इन्द्रिय ट्ट दर्शनेन्द्रिय (Macula)

इन्द्रियार्थ ट्ट रूप (Vision)

इन्द्रिय द्रव्य ट्ट तेजोमहाभूत (Rods & cones)

इन्द्रियाधिष्टान – चक्षु

इन्द्रियबुद्धि – चक्षुबुद्धि (Visual cortex)

Indriyaartha Sannikarsha: The 3 stages are;

1. Conduction of light rays reflected by the object to the eye
2. Refraction of light rays inside the eye

3. Convergence of light rays inside the eye on the drishti patala

Role of Doshas

1. वात:- Conduction is the main function of vata. The चल, सूक्ष्म, लघु properties of vata motivate this function.
2. पित्त :- Has no direct involvement in this stage.
3. कफ : From the anatomical configuration of the eye, it is clear that refractive media are having predominance of jala mahabhuta and kapha as predominant dosha. Normal consistency of Kapha helps in proper conduction. Any vikruthi in these properties deranges this process & may manifest diseases.

रूपलोचनम् (Analyses of the Subject)

This is the most complicated stage, in which analysis of the object is performed. Once the light rays converge on the drishti patalam, a series of reactions takes place. They are mainly:-

1. Photochemical changes.
2. Electrical changes.
3. Nervous stimulation.

c) ज्ञानोत्पत्तिः

In this step the visual impulse formed is converted to actual visual sense. In other words, प्रत्यक्ष ज्ञानं of the roopa is developed. The sense once gained should be stored in such a way that it can be recollected and reproduced as and when necessary. The store place is not inside the eye. So the details collected by the alochaka pitta is carried out of the organ, and brought to the buddhi where it is confirmed and stored[59, 60].

1) Conduction of the impulse from the drishtipatalam to the buddhi.

2) Transformation of इन्द्रिय संवेदकं(visual impulse) to इन्द्रिय ज्ञानं (visual sense).

Human beings have the perception of the objects of indriyas by that particular indriya only, because the origin of both is similar. One indriya cannot perceive the object of another indriya.

Eye which receives the light and light which illuminates the objects both are derivatives of teja mahabhuta. Hence eye perceives only rupa of the object and not other characters like sound etc.

Rupa is the adhibthuta, god surya is adhidaiva of chakshu which is adhyatma (pertains to soul) [61,62].

Importance of doshas in jnaanotpatti:

Vaayu: वा गति गन्धनयोः वायुः।

Gati here can be taken to the light rays traveling from the object to the retina through the refracting media, and then the impulses traveling from retina to the brain and viceversa[63]

- Functions of Vaayu: इन्द्रियार्थोप संप्राप्तिं.....॥

The arthas like roopa etc of chakshu and other indriyas are made available to the respective indriyas by Vaayu. The perception of Roopa without any disruption is the function of Adhooshita vaayu.

Nourishment to Indriyaas:- By Praanavaayu

The nourishment to the respective aashayas is carried by Praanavaayu.

In drishti patala, pranavayu is the activating and controlling factor. Its sthana is in the head and controls the function of alochaka pitta in the drishti patala[64].

उदान वायु कर्मः / Role of udana vaayu

The bahya form of prayatna is mainly for roopadi vishaya grahana. This function can occur only in the presence of manas. No vishayopalabdi occurs when either there is mana apravrutti or some obstruction in bahya vishaya grahana marga[65].

Role of Mind

Even if vata and pitta are in good condition, presence of mind is absolutely necessary for the smooth functioning of the eye.

Alochaka pitta analyses the object only in the presence of mind.

व्यान वायु कर्मः/ role of vyaana vaayu[66]:

Among the 5 karmas of vyana vaayu, nimesha and unmesha are related to the netra[67].

कृद्धश्च कुरुते रोगान् प्रायशः सर्वदेहगान्॥

And vitiated vyaana vaayu brings about sarvadehaga vyaadhis and inturn netra rogas also[68].

Vitiated vaayu brings about dysfunctioning of indriyas.

Pitta: तप सन्तापे। which brings about santapa. Here it can be taken to electrical activities that are occurring in the process of impulse transmission.

आलोचको दर्शकः। Pitta which is located in the eye is known as Alochakagni. Its function is to form the image of an external object presented to the eye[69].

रूपालोचनतः स्मृतं दृक्स्थमालोचकं । Alochakapitta is situated in the eye and its function is rupagrahana or forming images presented to it.

Bhela[70] has envisaged two aspects of alochakapitta viz. chakshurvisheshika and buddhirvaisheshika. He has quoted atreya punarvasu, as saying that alochaka is that which is excited by varsha (rain), sheeta (cold) and atapa (sun). The chakshurvisheshika alochaka pitta begin its action after the activation of atma and manas, when the object has made contact with it, leading to the production in chitta,the knowledge of the characteristics, form, color etc of such things as flowers, fruits, leaves etc. Buddhirvaisheshika is that which is located in shringataka, between the two eyebrows. It seizes subtle objects, retains and recalls them. This is the factor which enables concentration, responses and cogitation.

Kapha: श्लिष् आलिङ्गने। the compactness of eye, its Bandhana are all brought about by Shleshma.

Tarpaka Kapha: Increases the efficiency of its designated work by increasing the qualities of Mastaka

Majja. Akshitarpana[71] is the function of tarpaka kapha which is present in shira.

Physiological Function of Pitta in eye

Pitta responsible for ranjana, prakashana, varnakara including prabhakara i.e. ranjana, alochaka and Bhrajaka may have to be grouped together, under a category as their function are essentially the formation of different kinds of pigments. Viz, the pigment, in the retina responsible for vision and colour perception; the pigments that confers on rakta is characteristic colour and specific function and pigment of the skin, eye and hair etc.

Physiological Function of Kapha in eye

The eye is composed of panchamahabhootas. The most expose part of the eye is sweta mandala (i.e. conjunctiva/sclera) and predominance of jalamahabhoota connected to kapha dosa. Physiologically the kapha dosa acts as a slaismika ojas (tarpaka kapha) have a Lysozymic property and killed the micro-organism which produces the conjunctivitis in disturbance.

NETRA VYADHI

In Sushrut Samhita, Shalakya tantra is described in Uttartantra by Acharya Sushruta. He has described netrarogas in first seventeen chapters. In ancient era with limited sources, Acharyas had performed detailed observations and diagnosis of eye diseases. Illumination is main source for examination of eye. But at time of Acharya Sushruta, he did eye examination just under bright sun light. Details of classification of diseases according to vitiated doshas and sadhyasadhyatva is given in Samhita. Among seventysix netrarogas, seventeen are said as incurable. Four incurable vataja diseases are Hathadhimantha, Gambhirika, Nimesha, Vatahatavartma. Kaphastrava is incurable disease due to vitiation of kapha dosha. Four raktaja diseases are Raktastrava, Shonitarsha, Ajakajata, Savrana shukla1. Four sannipataja diseases are Puyasrava, Nakulandhya, Akshipakatyaya and Alaji. Two Bahya linganashas are incurable diseases. Clinical features of these diseases may be correlated with different modern concepts. Some diseases are incurable even today with advanced techniques and surgical methods. But due to advanced knowledge of anatomy and histology of tissues, knowledge of physiology, biochemistry of tissue, advanced examination techniques, invention of drugs like antibiotics, steroids, various modes of drug administration, Laser and other surgical techniques; these all factors help in improvement of prognosis of asadhya diseases. Here is an effort to reevaluate the prognosis mentioned by Sushruta in modern era with outcome of treatment.

Netra Roga Sankya and Classification

In Auryvedic classics netravikaras are classified into various types based on their adhishtana, chikitsa, sadhyasadhyata etc. Acharya shushrutha has mentioned 76 eye diseases. Charaka has explained only 4 types of netrarogas based on doshas. According to Vagbhata and Sharngadhara there are 94 types of netrarogas.Bhavaprakasha and Yogaratnakara have mentioned 78 and 76 types of netravikaras respectively.

Table No 5: Classification of netra vyadhi according to Adhistana

ADHISTANA	S.S	A.S	A.H	M.N	B.P	Y.R	SHA.S
Varthmagatha	21	24	24	21	21	21	24
Sandhigatha	09	09	09	09	09	09	09
Shuklagatha	11	13	13	11	11	11	13
Krishnagatha	04	05	05	04	04	04	05
Drishtigatha	12	27	27	12	14	12	08

Sarvakshigata	17	16	16	17	17	17	08
Bahya	02	--	02	02	02	02	27
Total	76	94	94	76	78	76	94

Table No 6 : No of Vyadhi according to Acharyas

	SUSH	A.S.	A.H.	MAD	Y.R	BH.P.	SAR	NETRA PRAK	KARALA	R.R. SAM
Vartma Mandala	21	24	24	21	21	21	24	24	27	24
Sandhi	09	09	09	09	09	09	09	09	09	09
Shukla Mandala	11	13	13	11	11	11	13	13	13	01
Krishna Mandala	04	5	5	4	4	4	5	5	6	5
Dristi Mandala	12	27	27	12	12	14	8	-	25	8
Sarvagata	17	16	16	17	17	17	8	-	16	8
Others	2	-	-	2	2	2	27	22	-	17
Total	76	94	94	78	78	78	94	100	96	94

Susrutha has also classified the diseases on the basis of the mode of treatment.

Table No 7: Classification of the Akshi Rogas on the basis of mode of treatment

Chedya	11
Bhedya	5
Lekhya	9
Vedhya	15
Without Shastras	12
Yapya	7
Asadhya	17
TOTAL	76

Classification of Eye Diseases on the basis of Adhistana

Netra Roga Nidana

Acharya Sushruta and others have described the following causes for eye diseases, which can further be subdivided into general and specific cause.

1. उष्णाभितप्तस्य जलप्रवेशात् - Taking cold water bath, when the body is hot causes eye diseases. When body is too hot, the vessels in the body are become dilate & the volume of fluids also increase, then if body temperature is suddenly dropped the vessels constrict due to cold water bath, the vasculature is going to damaged. This

phenomenon causes circulatory disturbances in the vessels; which in turn affects the mechanism of nutrition to the concerned organ & it leads to eye diseases also.

2. दूरेक्षणात् - To see distant object continuously eg. Astronomers, Scientists in the observatories, military persons at boarder, Navy personal to see signals. Eye can visualize the things up to some distance without any strain, but the gazing is going to affect by long time vision and it results into eye strain & later leads to eye disorders.
3. स्वप्नविपर्ययात् च– Alteration of the pattern of sleep, Diwa swapna i.e. Day sleeping causes Kapha vitiation & Ratrijagrana causes Vata – Pitta Prakopa.
4. प्रसक्तसंरोदन - Continuous weeping, if we cry for prolonged time leads to excessive stimulation of Lacrimal gland, by this we get more tears and because of this nutrients will wash away and bacterio static activity of conjunctival sac also get destroyed.
5. कोप– (Excessive anger): By indulging in anger continuously or excessive indulging Pittakara ahara and vihara causes pitta vikaras in the eye.
6. शोक (Grief) :- By excessive indulging in shoka, it leads to vitiation of Vata and causes Vataja netra vikara in the eye.
7. क्लेश (Stress): - Physical & Mental exhaustion leads to shareera and Manasa Doshas & ultimately may leads to eye diseases also
8. अभिघातात (i.c. due to traumatic injury):- Minute irritative injuries or contusion injuries or perforating injuries cause a great loss to the eye, if proper care is not taken blindness follow immediately.
9. अतिमैथुनात् – Over Indulgence in sexual intercourse causes Dhatu kshaya and also eye diseases.
10. शुक्तारनालाम्ल कुलत्थमाष निषेवणात् Shukta, Arnala (Sour food item) taken excessively causes

Netra vikaras because the above things are Sandhana Dravyas having the the properties

oppose to Ojas & their excess use causes Ojokshaya & leads eye diseases. Kulatha: -

Kashaya rasa, Katuvipaka; if taken for a long time vitiates and causes Raktaja Pittaja

disorders of eye.Masha: - Guru, Madhura, Snigda - if taken for a long time causes kaphaja

disorders of the eye.

11. वेगविनिग्रहात् By controlling essential urges like passing urine, or defecating stools, (these are 13 such urges which should not be controlled as per Ayurveda) produces udavartha vyadhi (Vitiation of Vata) & also causes eye strain and other vataja eye disorders.
12. स्वेदाद Excessive fomentation or sudation to the eye :- Swedana Karma is contraindicated to the eyes, if necessary Mrudu Sweda is suggested with perfect care. Its excessive use causes Pittaja Raktaja disorder of eye.
13. धूमनिषेवणात् Smoking is considered as harmful for eyes according to Ayurveda as well as modern medicine. As per Ayurveda, smoking may vitiate Pitta and Vata by increasing its Tikshna, Ushna and Ruksha Gunas, hence it can be considered as one of the important factors in the causation of Timira.
14. च्छर्दे:विघातात् Suppressing the vomiting urge leads to udavartha vyadhi that causes eye strain and visual problems. Suppressing vomiting leads to kushta eye disorders etc.
15. वमनातियोगात् - Indulging excessive vamana therapy produces complication like protrusion of eye ball (Akshnor Vyavruthi) and Retinal or sub conjunctival haemorrhages etc.
16. बाष्पग्रहात् suppressing the tears produces Ashruja Udavartha in which doshas get obstructed in the Ashru vaha srotas and causes eye disease
17. सूक्ष्मनिरीक्षणात् -observing the minute things regularly causes strain to the cilliary muscles and lens results in visual problems e.g. Pathology technicians, Diamond Cutter, Wrist watch repairers, Tailors, ladies doing embroidery work etc[72].

Additional Points various acharys

- **Bhavamishra**
- रजो धूम निशेवणात्– Exposing to dust, smoke causes foreign body sensation in the eye
- अति शीघ्र यानात् - it causes discomfort and strain to the body and also eyes.
- ऋतुञ्च विपर्ययेन्-Taking hot things in Ushna ritu causes vitiation of Pitta & Taking cool things in Sheetha ruthu causes vitiation of Kapha
- **Yogaratnakara**
- द्रवान्नपानाति निशेवणात् - Taking more liquid diet-causes hypo vitaminosis leads to eye disorders.
- अति मद्यपानात् -Excessive intake of alcoholic preparations causes Ojo kshaya and visual disorders.
- **Dalhana**
- अवाक्शिरोत्युच्छ्रिता -Sleeping by putting the head in the downward position than body. (Cervical, Brachial neuralgia) sleeping by putting the head in the upward position than body.
- ज्वरोपताप -Due to high fever or sun stroke, head including eyes are affected and causes the eye diseases.
- **Hareetha Samhita**
- Extreme intake of Ushna, Kshara, Katu rasa, food or drugs causes eye diseases.
- **Sharangadhera**
- The eye exposing to bright things causes Timira and other eye diseases.

Other causes of netra rogas

1. Pratishyaya / Rhinitis: Andhya (blindness) and severe eye diseases results as a complication of pratishyaya.
2. Exccessive bloodletting: Excessive blood loss results in blurring of vision and errors of refraction.
3. Injury to vital parts: Trauma to Avarta and Apanga Marma may lead to loss of vision either complete or partial.

4. Guggulatiyoga: Excessive intake of Guggulu leads to Timira.
5. Grahani Roga:Timira has been considered as one symptom among others of Grahani
6. Roga complications. (Ch.Chi.15/61)

Sampraapti

सिरानुसारीभिः दोषैः विगुणैः ऊर्ध्वमागतैः। जायन्ते नेत्रभागेषु रोगाः परमदारुणाः॥ 6 (S.S.Ut.1 /20 p.597)

The vimargagamana of the increased doshas towards drushti through Urdhwagaami siras results in various complicated diseases of netra. When they get localized in Drushtimandala due to its susceptibility because of weakness caused by one or more nidanas results in any of 12 drushtimandalagata rogas.

Acharya Charaka states that when humors get provoked in the seats of the sense organs, they cause either the impairment or the irritation of the senses concerned

Purva Rupa

Dirtiness, congestion, lacrimation, itching, stickiness, heaviness, burning sensation, pricking pain, redness etc are the prodromal features of the eye diseases. There may be feeling as if the cavity of the eye lids is full of painful bristles, impairment in vision or function of the eyes as compared with what they were before. As soon as the above features are seen, the intelligent clinician should regard that (eye) to have become afflicted with doshas.

Rupa (Clinical Features)[73]

Doshas which have become aggravated, travel through the siras (blood vessels) and get localized in the prathama patala (the first layer) then person sees all objects hazy (not clear).

Accoding to vagbhatta [74]When the Malas (Doshas) moving in the siras get localized in the first patala the person sees the objects hazy & sometimes see the object clearly without any obvious causes.

When[75] the doshas invade the second layer, sight/vision becomes greatly deranged, the person sees (shapes of) flies, mosquitoes, hairs, net, circles, flags, miraze, rings, different movements of stars, rain from sky and darkness, thinks far off objects as

though present nearby and objects nearby as present far away because of disorders of sight, due to this he will not be able to see the eye (hole) of the needle though makes great efforts.

NETRASTARVA

When doshas enter the netrasandhi through the tear channels they cause painless secretion through kaninikasandhi. Netrasravas are classified into four types based on nature of the discharge.

1. **Puyastrava:**

   Dosha: Tridosha

   Sthana: Sandhi

   The suppuration in netrasandhi produces variety of pus discharges due to the vitiation of tridoshas. As all three doshas are involved, it exhibits respective symptoms.

2. **Kaphasrava**

   Dosha: Kapha

   Sthana: Sandhi

   Sleshmasrava is characterized by white, thick and sticky discharge which is painless.

3. **Raktasrava**

   Dosha: Rakta

   Sthana: Sandhi

   Raktastrava is characterized by hot blood stained discharge due to vitiation of Rakta.

4. **Pitta strava**

   Doshas: Pitta

   Sthana: Sandhi

   Pittastrava characterized by water like thin and hot discharges of yellowish or bluish colour from the middle of sandhi.

ANATOMY OF EYE

Study compromise in these headings,

I. Embryology
II. Osteology
III. Eyeball
IV. Lacrimal apparatus

I. Embryology of Eye

The eyes begin to develop as a pair of diverticula from the lateral aspects of the forebrain. These diverticula make their appearance before the closure of the anterior end of the neural tube; after the closure of the tube they are known as the **optic vesicles.** They project toward the sides of the head, and the peripheral part of each expands to form a hollow bulb, while the proximal part remains narrow and constitutes the **optic stalk**. The ectoderm overlying the bulb becomes thickened, invaginated, and finally severed from the ectodermal covering of the head as a vesicle of cells, the **lens vesicle,** which constitutes the rudiment of the crystalline lens. The outer wall of the bulb becomes thickened and invaginated, and the bulb is thus converted into a cup, the **optic cup,** consisting of two strata of cells. These two strata are continuous with each other at the cup margin, which ultimately overlaps the front of the lens and reaches as far forward as the future aperture of the pupil. The invagination is not limited to the outer wall of the bulb, but involves also its postero-inferior surface and extends in the form of a groove for some distance along the optic stalk, so that, for a time, a gap or fissure, the **choroidal fissure,** exists in the lower part of the cup. Through the groove and fissure the mesoderm extends into the optic stalk and cup, and in this mesoderm a blood vessel is developed; during the seventh week the groove and fissure are closed and the vessel forms the central artery of the retina.

The **retina** is developed from the optic cup.

The optic stalk is converted into the **optic nerve** by the obliteration of its cavity and the growth of nerve fibers into it.

The **optic chiasma** is formed by the meeting and partial decussation of the fibers of the two optic nerves.

The **crystalline lens** is developed from the lens vesicle,

The **vitreous body** is developed between the lens and the optic cup.

The **anterior chamber** of the eye appears as a cleft in the mesoderm separating the lens from the overlying ectoderm.

The fibers of the ciliary muscle are derived from the mesoderm, but those of the Sphincter and Dilatator pupillæ are of ectodermal origin, being developed from the cells of the pupillary part of the optic cup.

The **sclera** and **choroid** are derived from the mesoderm surrounding the optic cup.

Eyelids are formed as small cutaneous folds, which about the middle of the third month come together and unite in front of the cornea.

The lacrimal sac and nasolacrimal duct result from a thickening of the ectoderm in the groove, nasoöptic furrow, between the lateral nasal and maxillary processes. This thickening forms a solid cord of cells which sinks into the mesoderm; during the third month the central cells of the cord break down, and a lumen, the nasolacrimal duct, is established. The lacrimal ducts arise as buds from the upper part of the cord of cells and secondarily establish openings (puncta lacrimalia) on the margins of the lids. The epithelium of the cornea and conjunctiva, and that which lines the ducts and alveoli of the lacrimal gland, are of ectodermal origin, as are also the eyelashes and the lining cells of the glands which open on the lid-margins.

II. Osteology

The orbits are two quadrilateral pyramidal cavities, situated at the upper and anterior part of the face, their bases being directed forward and lateral and their apex backward and medially, so that their long axes will meet over the body of the sphenoid.

Orbital Measurements

- Volume 30 ml
- Globe volume 7.2 ml
- Width 45 mm
- Height 35 mm
- Maximum circumference1.0 cm behind rim
- Length: medial wall 40-45 mm

Parts

- Roof
- Floor
- Wall - medial and a lateral wall
- Base
- An apex

Roof

- Shape- concave, directed downward, and slightly forward
- Bones- in front by the orbital plate of the frontal
  Behind by the small wing of the sphenoid
- Structures present in roof
  - **Trochlear fovea** presents *medially,* for the attachment of the cartilaginous pulley of the superior obliqus.
  - **Lacrimal fossa** lies *laterally* for the lodging of lacrimal gland.

Floor

- Shape- directed upward and laterally, and is of less extent than the roof.
- Bones- chiefly by the orbital surface of the maxilla;
  by the orbital process of the zygomatic bone,
  by the orbital process of the palatine.
- Structures present in floor
  - Suture between the maxilla and zygomatic bone,
  - Infraorbital groove middle of the floor, infraorbital canal and transmitting the infraorbital nerve and vessels.

Medial wall

- Shape-Nearly vertical, and is formed from before backward
- Bones-By the frontal process of the maxilla, the lacrimal, the ethmoid, and a small part of the body of the sphenoid.
- Structures present in medial wall
  - Three vertical sutures - lacrimomaxillary, lacrimoethmoidal, and sphenoethmoidal.
  - **lacrimal groove** lodges the lacrimal sac
  - **posterior lacrimal crest** behind the groove

Lateral wall

- Shape-directed medialward and forward,
- Bones-by the orbital process of the zygomatic and the orbital surface of the great wing of the sphenoid
- Structures present in lateral wall
    - orbital tubercle and the orifices- transmit the branches of the zygomatic nerve
    - **Superior orbital fissure** present between roof and the lateral wall, transmits oculomotor, trochlear, ophthalmic division of the trigeminal, and abducent nerves enter the orbital cavity, also some filaments from the cavernous plexus of the sympathetic and orbital branches of the middle meningeal artery. Ophthalmic vein and the recurrent branch from the lacrimal artery to the dura mater.
    - **Inferior orbital fissure** present between lateral wall and the floor are separated posteriorly, transmits the maxillary nerve and its zygomatic branch, the infraorbital vessels, and the ascending branches from the sphenopalatine ganglion.

Base

- Shape-quadrilateral in shape
- Bones-by the supraorbital arch of the frontal bone, zygomatic bone and maxilla,
- Structures present in Base
    - **supraorbital notch** or **foramen** passage of the supraorbital vessels and nerve

Apex

It is Short, cylindrical canal, situated at the back of the orbit, corresponds to the optic foramen and transmits the optic nerve and ophthalmic artery.

The Nine Canals and Fissures of the Orbit

It will thus be seen that there are nine openings communicating with each orbit, viz., the optic foramen, superior and inferior orbital fissures, supraorbital foramen, infraorbital canal, anterior and posterior ethmoidal foramina, zygomatic foramen, and the canal for the nasolacrimal duct.

Table No 8: Structure passing through Orbit

Sl no	**Foramina**	**Structure passing through**
1.	Optic foramen	Optic nerve, ophthalmic artery, sympathetic fibers
2.	Superior orbital fissure	lacrimal, frontal, trochlear nerves, CN III (superior and inferior divisions), nasociliary, CN VI, superior ophthalmic vein, sympathetics/parasympathetics
3.	Inferior orbital fissure	Sphenoid, maxillary, and palatine bones; V-2: infraorbital and zygomatic nerves; inferior ophthalmic vein
4.	Supraorbital foramen	Frontal nerve (supraorbital nerve, V-1)
5.	Infraorbital foramen	Infraorbital neurovascular bundle (V-2)
6.	Anterior ethmoidal foramen	
7.	Posterior ethmoidal foramen	
8.	Zygomatic foramina	zygomaticotemporal neurovascular bundles
9.	Zygomaticofacial	
10.	Nasolacrimal duct	
11.	Frontosphenoid foramina	anastomosis of recurrent middle meningeal and lacrimal arteries
12.	Frontosphenoid foramen	

III. **Eyeball**

Studied in two aspects

1. Eye ball
2. The accessory organs of the eye include the ocular muscles, fascia, eyebrows, eyelids, conjunctiva and lacrimal apparatus.

Eye ball

The Tunics (Layers) of the Eye ball from without inward the three tunics are:

1. A fibrous layer consisting of the Sclera (five-sixths) behind and the Cornea(one sixth) in front
2. A vascular pigmented layer comprising, from behind forward, Choroid, Ciliary body and Iris

3. A nervous layer- Retina.

The Sclera

It is a firmmembraneserving to maintain the form of ball. It is much thicker behind than in front; the thickness of its posterior part is 1 mm.

Surface

- **External surface-**White in color, smooth, except at the points where the Recti and Obliqui are inserted into it; its anterior part is covered by the conjunctival membrane.
- **Inner surface** brown in color and marked by grooves in which the ciliary nerves and vessels are lodged. Behind it is pierced by the optic nerve and is continuous through the fibrous sheath of this nerve with the dura mater.

In front, the sclera is directly continuous with the cornea, the line of union being termed the **sclero-corneal junction.** In the inner part of the sclera close to this junction is a circular canal, the **sinus venosus sclera** (*canal of Schlemm*).

The aqueous humor drains into the scleral sinuses by passage through the "pectinate villi" which are analogous in structure and function to the arachnoid villi of the cerebral meninges.

Cornea

It is transparent part of the external layer,circular in outline. It is convex anteriorly and projects like a dome in front of the sclera. Its degree of curvature varies in different individuals, and in the same individual at different periods of life, being more pronounced in youth than in advanced life.

The cornea consists from before backward of four layers,

- Corneal epithelium, continuous with that of the conjunctiva
- Substantia propria
- Posterior elastic lamina
- Endothelium of the anterior chamber.

Vessels: The cornea is a non-vascular structure; the capillary vessels ending in loops at its circumference are derived from the anterior ciliary arteries.

Lymphatic vessels have not yet been demonstrated.

Nerves- nerves are numerous and are derived from the ciliary nerves.

Choroid

Is a thin, highly vascular membrane, of a dark brown or chocolate colour, posterior five-sixths of the bulb, and extends as far forward as the ora serrata of the retina. The ciliary body connects the choroid to the circumference of the iris. The iris is a circular diaphragm behind the cornea, and presents near its center a rounded aperture, the pupil.

Its outer surface is loosely connected by the lamina suprachorioidea with the sclera; its inner surface is attached to the pigmented layer of the retina.

Choroid proper, consisting of two layers

- An outer- composed of small arteries and veins, with pigment cells interspersed between them
- An inner, consisting of a capillary plexus

One of the functions of the choroid is to provide nutrition for the retina, and to convey vessels and nerves to the ciliary body and iris.

Ciliary Body

It comprises the orbiculusciliaris, the ciliary processes, and the Ciliaris muscle.

- Orbiculusciliaris - 4 mm. in width, directly continuous with the anterior part of the choroid
- Ciliary processes - They vary from sixty to eighty in number, lie side by side, and may be divided into large and small; the former are about 2.5 mm. in length, and the latter, consisting of about one-third of the entire number, are situated in spaces between them, but without regular arrangement.
- Ciliaris muscle - consists of unstriped fibers: it forms a grayish, semitransparent, circular band, about 3 mm. broad, on the outer surface of the fore-part of the choroid. consists of two sets of fibers,
    - Meridional - more numerous, arise from the posterior margin of the scleral spur they run backward, and are attached to the ciliary processes and orbiculusciliaris.
    - Circular are internal to the meridional ones, and in a meridional section appear as a triangular zone behind the filtration angle and close to the circumference of the iris.

The Ciliaris muscle is the chief agent in accommodation, i. e., in adjusting the eye to the vision of near objects. When it contracts it draws forward the ciliary processes, relaxes the suspensory ligament of the lens, and thus allows the lens to become more convex.

Iris

It has received its name from its various colors in different individuals. It is a thin, circular, contractile disk, suspended in the aqueous humor between the cornea and lens, and perforated a little to the nasal side of its center by a circular aperture, the **pupil.**

By its periphery it is continuous with the ciliary body, and is also connected with the posterior elastic lamina of the cornea by means of the pectinate ligament.

The iris divides the space between the lens and the cornea into,

- An anterior - is bounded in front by the posterior surface of the cornea; behind by the front of the iris and the central part of the lens
- Posterior chamber - behind the peripheral part of the iris, and in front of the suspensory ligament of the lens and the ciliary processes.

In the adult the two chambers communicate through the pupil, but in the fetus up to the seventh month they are separated by the *membranapupillaris*

Muscle

Involuntary and consist of circular and radiating fibers.

- **Circular fibers** form the Sphincter pupillae; they are arranged in a narrow band about 1 mm. in width which surrounds the margin of the pupil toward the posterior surface of the iris
- **Radiating fibers** form the Dilatator pupillae; they converge from the circumference toward the center, and blend with the circular fibers near the margin of the pupil.

The color of the iris is produced by the reflection of light from dark pigment cells underlying a translucent tissue, and is therefore determined by the amount of the pigment and its distribution throughout the texture of the iris.

Vessels - derived from the long and anterior ciliary arteries,

Nerves- long and short ciliary; the former being branches of the nasociliary nerve, the latter of the ciliary ganglion

Retina

The retina is soft, semitransparent, and of a purple tint in the fresh state, owing to the presence of a coloring material named **rhodopsin** or **visual purple;** but it soon becomes clouded, opaque, and bleached when exposed to sunlight. It is a delicate nervous membrane, upon which the images of external objects are received.

Surface

- outer surface is in contact with the choroid
- inner surface with the hyaloid membrane of the vitreous body.

Behind, it is continuous with the optic nerve; it gradually diminishes in thickness from behind forward, and extends nearly as far as the ciliary body, where it appears to end in a jagged margin, the **ora serrata.**

Macula lutea is an oval yellowish area at a point in which the sense of vision is most perfect.

Fovea centralis, in the macula is a central depression, here retina is exceedingly thin, and the dark color of the choroid is distinctly seen through it. About 3 mm. to the nasal side of the macula lutae is the entrance of the optic nerve (*optic disk*) this is the only part of the surface of the retina which is insensitive to light, and it is termed the **blind spot.**

The retina consists of 2 layers

- An outer pigmented layer - single stratum of cells.
- An inner nervous stratum or retina proper. supported by a series of nonnervous or sustentacular fibers, and, when examined microscopically by means of sections made perpendicularly to the surface of the retina, are found to consist of seven layers,
    - Stratum opticum.
    - Ganglionic layer.
    - Inner plexiform layer.
    - Inner nuclear layer, or layer of inner granules.
    - Outer plexiform layer.
    - Outer nuclear layer, or layer of outer granules.
    - Layer of rods and cones

The **rods** are cylindrical, of nearly uniform thickness, and are arranged perpendicularly to the surface. Each rod consists of two segments, an outer and inner, of about equal lengths. The segments differ from each other as regards refraction and in their behavior toward coloring reagents; the inner segment is stained by carmine, iodine, etc.; the outer segment is not stained by these reagents, but is colored yellowish brown by osmic acid. The outer segment is marked by transverse striae, and tends to break up into a number of thin disks superimposed on one another; it also exhibits faint longitudinal markings. The deeper part of the inner segment is indistinctly granular; its more superficial part presents a longitudinal striation, being composed of fine, bright, highly refracting fibrils. The visual purple or rhodopsin is found only in the outer segments.

The **cones** are conical or flask-shaped, their broad ends resting upon the membrana limitans externa, the narrow-pointed extremity being turned to the choroid. Like the rods, each is made up of two segments, outer and inner; the outer segment is a short conical process, which, like the outer segment of the rod, exhibits transverse striae. The inner segment resembles the inner segment of the rods in structure, presenting a superficial striated and deep granular part, but differs from it in size and shape, being bulged out laterally and flask-shaped. The chemical and optical characters of the two portions are identical with those of the rods.

Artery

Central artery of retina The artery immediately bifurcates into an upper and a lower branch, and each of these again divides into a medial or nasal and a lateral or temporal branch, the branches of the arteria centralis retinae do not anastomose with each other—in other words they are terminal arteries.

Refracting media

1. Aqueous humor - It fills the anterior and posterior chambers of the eyeball. It is small in quantity, has an alkaline reaction, and consists mainly of water, less than one-fiftieth of its weight being solid matter, chiefly chloride of sodium.
2. Vitreous body body forms about four-fifths of the bulb of the eye. It fills the concavity of the retina, and is hollowed in front, forming a deep concavity, the **hyaloid fossa,** for the reception of the lens. It is transparent, of the consistence of thin jelly, and is composed of an albuminous fluid enclosed in a delicate

transparent membrane, the **hyaloid membrane.** In the center of the vitreous body, running from the entrance of the optic nerve to the posterior surface of the lens, is a canal, the **hyaloid canal,** filled with lymph and lined by a prolongation of the hyaloid membrane. This canal, in the embryonic vitreous body, conveyed the arteria hyaloidea from the central artery of the retina to the back of the lens. The fluid from the vitreous body is nearly pure water; it contains, however, some salts, and a little albumin. No bloodvessels penetrate the vitreous body, so that its nutrition must be carried on by vessels of the retina and ciliary processes, situated upon its exterior.

3. **Lens**

The lens, much like the cornea, is made from embryonic skin and is also transparent; however it is able to change focus, which the cornea is not able to do. This function allows humans to focus on an object and any distance. A camera would focus by moving its hard lenses, but the human eye's lens is rubber like and flexes to focus quickly through changing its shape. As humans age, the lens loses flexibility which affects clarity and the ability to focus as compared to its original capabilities

The accessory organs of the eye include the **ocular muscles,** the **fascia,** the **eyebrows,** the **eyelids,** the **conjunctiva,** and the **lacrimal apparatus.**

Ocular Muscles

1. Levatorpalpebrae superioris
2. Rectus superior
3. Rectus inferior
4. Rectus medialis.
5. Rectus lateralis.
6. Obliquus superior
7. Obliquus inferior

Fascia

1. **Fascia of Bulb** (*capsule of Ténon*) thin membrane which envelops the bulb of the eye from the optic nerve to the ciliary region, separating it from the orbital fat. Its inner surface is smooth, and is separated from the outer surface of the sclera by the **periscleral lymph space.**

   medial and **lateral check ligaments**

2. **Orbital Fascia** forms the periosteum of the orbit. It is loosely connected to the bones and can be readily separated from them.
3. **Orbital septum** is a membranous sheet, attached to the edge of the orbit, where it is continuous with the periosteum.

Eyebrows (*supercilia*) are two arched eminences of integument, which surmount the upper circumference of the orbits, and support numerous short, thick hairs, directed obliquely on the surface. The eyebrows consist of thickened integument, connected beneath with the Orbicularis oculi, Corrugator, and Frontalis muscles.

Eyelids (*palpebræ*) are two thin, movable folds, placed in front of the eye, protecting it from injury by their closure. The upper eyelid is the larger, and the more movable of the two, and is furnished with an elevator muscle, the Levatorpalpebræ superioris. When the eyelids are open, an elliptical space, the palpebral fissure is left between their margins, the angles of which correspond to the junctions of the upper and lower eyelids, and are called the palpebral commissures or canthi.

- Lateral palpebral commissure (outer canthus) is more acute than the medial and the eyelids here lie in close contact with the bulb of the eye
- Medial palpebral commissure (inner canthus) is prolonged for a short distance toward the nose, and the two eyelids are separated by a triangular space, called lacuslacrimalis. At the basal angles of the lacuslacrimalis, on the margin of each eyelid, is a small conical elevation, the lacrimal papilla, the apex of which is pierced by a small orifice, the lacrimal punctum from here the commencement of the lacrimal duct.

Tarsi (*tarsal plates*) are two thin, elongated plates of dense connective tissue, about 2.5 cm. in length; one is placed in each eyelid, and contributes to its form and support.

- **Superior tarsus** (*superior tarsal plate*), the larger and semilunar form, about 10 mm. in breadth at the center, and gradually narrowing toward its extremities. Levatorpalpebræ superioris is attached to the anterior surface of this plate
- **Inferior tarsus** (*inferior tarsal plate*), the smaller, is thin, elliptical in form, and has a vertical diameter of about 5 mm.

Eyelashes (*cilia*) are attached to the free edges of the eyelids, they are short, thick, curved hairs, arranged in a double or triple row. Upper eyelid has more numerous and

longer than those of the lower. Near the attachment of the eyelashes are the openings of a number of glands called **ciliary glands,** arranged in several rows close to the free margin of the lid.

Glands

1. Tarsal Glands (Meibomian glands) are modified sebaceous glands, situated upon the inner surfaces of the eyelids, between the tarsi and conjunctiva, There are about thirty in the upper eyelid, and somewhat fewer in the lower. Their ducts open on the free magins of the lids by minute foramina.

Conjunctiva

Mucous membrane of the eye, It lines the inner surfaces of the eyelids and is reflected over the forepart of the sclera and cornea.

- **Palpebral Portion** is thick, opaque, highly vascular, and covered with numerous papillae, its deeper part presenting a considerable amount of lymphoid tissue. The line of reflection of the conjunctiva from the upper eyelid on to the bulb of the eye is named the superior fornix and that from the lower lid the inferior fornix. At the lateral angle of the upper eyelid the ducts of the lacrimal gland open on its free surface; and at the medial angle it forms a semilunar fold, the plica semilunaris.
- **Bulbar Portion** -It is thin, transparent, destitute of papillae, and only slightly vascular. Upon the sclera the conjunctiva is loosely connected to the bulb of the eye,Upon the cornea, the conjunctiva consists only of epithelium, constituting the epithelium of the cornea.

Lacrimal apparatus

It is concerned with the tear formation & transport.

Study compromise in these headings,

1. Secretory system -Lacrimal gland- secretes the tears,
2. Excretory system- Excretory ducts, Lacrimal ducts, lacrimal sac and nasolacrimal duct- convey the fluid to the surface of the eye and then into the cavity of the nose.
3. Physiology Lacrimal apparatus
4. Pathology of Lacrimal apparatus

1. Lacrimal Gland

Location- is lodged in the lacrimal fossa, on the medial side of the zygomatic process of the frontal bone.

Shape -oval form, an almond

Parts

Anatomically it has 2 parts-:

1. Orbital part
2. Palpebral part

They are incompletely separated by levator palpebral muscle. Orbital portion is bigger than palpebral portion. The anterior portion of the palpebral part can be seen through the conjunctiva in the lateral portion of the superior fornix. 10 to 12 ducts from both portions open into the conjunctival sac just in front of the fornix. Few ducts open into the lateral portion of the inferior fornix also. The ducts from the orbital portion pass through the palpebral portion and hence, removal of the palpebral portion might result in loss of secretion of lacrimal fluid.

Ducts

Six to twelve in number, run obliquely beneath the conjunctiva for a short distance and open along the upper and lateral half of the superior conjunctival fornix.

The Lacrimal Ducts

The lacrimal ducts, one in each eyelid, commence at minute orifices, termed puncta lacrimalia, on the summits of the papillae lacrimales, seen on the margins of the lids at the lateral extremity of the lacuslacrimalis.

- The superior duct: smaller and shorter, bends at an acute angle, and passes medialward and downward to the lacrimal sac.
- The inferior duct: first descends, and then runs almost horizontally to the lacrimal sac. At the angles they are dilated into ampullæ; their walls are dense in structure and their mucous lining is covered by stratified squamous epithelium, placed on a basement membrane

Lacrimal Sac

It is the upper dilated end of the nasolacrimal duct, and is lodged in a deep groove formed by the lacrimal bone and frontal process of the maxilla. It is oval in form and measures from 12 to 15 mm. in length; its upper end is closed and rounded; its lower

is continued into the nasolacrimal duct. Its superficial surface is covered by a fibrous expansion derived from the medial palpebral ligament, and its deep surface is crossed by the lacrimal part of the Orbicularis oculi, which is attached to the crest on the lacrimal bone.

Nasolacrimal Duct

It is a membranous canal, about 18 mm. in length, which extends from the lower part of the lacrimal sac to the inferior meatus of the nose, where it ends by a somewhat expanded orifice, provided with an imperfect valve, the plica lacrimalis (Hasneri), formed by a fold of the mucous membrane. It is contained in an osseous canal, formed by the maxilla, the lacrimal bone, and the inferior nasal concha; it is narrower in the middle than at either end, and is directed downward, backward, and a little lateralward. The mucous lining of the lacrimal sac and nasolacrimal duct is covered with columnar epithelium, which in places is ciliated.

Histology

All lacrimal glands are serous acini, similar in structure to the parotid glands. Microscopically these consist of acini which are of two layers of cells, outer myoepithelial and inner layer of cylindrical cell which are secretory in nature.

Blood supply:

Lacrimal artery is the chief arterial supply to Lacrimal gland which is a branch of ophthalmic artery.

Venous drainage is from ophthalmic vein.

Nerve supply:

1. Sensory supply : Lacrimal nerve, It is a branch of the ophthalmic division of the fifth nerve.
2. Sympathetic supply : Carotid plexus of the cervical sympathetic chain.
3. Secretomotor fibres: Superior salivary nucleus.

Accessory lacrimal glands

1. Glands of Krause: These are microscopic glands lying below the palpebral conjunctiva between fornix and the edge of tarsus. We find around 42 numbers of small glands in the upper fornix and 6-8 in the lower fornix.

2. Glands of Wolfring: Present near the upper border of the superior tarsal plate and along the lower border of inferior tarsus.

The Tear Film

The tear film is a few-micron-thick aqueous film lining the ocular surface epithelium. It performs a number of functions, including protection of the ocular surface and providing nutrition for the cornea. Being the protective interface between the surrounding environment and the epithelium, the integrity of the film is essential for the health of the cornea and ocular surface. The tear film is affected by destabilising factors such as gravity, capillary forces induced by the menisci of the lids, and the surface tension of the aqueous interface that induces curvature of the interface and therefore de wetting of the ocular surface. Additionally, evaporation of the aqueous tear is a considerable factor that affects the tear film integrity[76].

Tear film having 3 layers,

1. Mucin layer
2. Aqueous
3. Lipid layers

1. Mucin Layer

Ocular mucus is composed of mucin, immunoglobulins, urea, salts, glucose, leukocytes, cellular debris, and enzymes[77].

Mucins are high molecular weight glycoproteins that are heavily glycosylated: 50% to 80% of their mass can be attributed to their carbohydrate side chains[3].

Mucins are classified as either membrane-associated or secretory. **Secretary mucins** are further divided into two groups: large gel-forming mucins or small soluble mucins. **Membrane-associated mucins** form the glycocalyx, a dense barrier to pathogen penetrance, at the epithelial cell–tear film interface[78].

This property provides a lubricating surface that allows lid epithelia to glide over the corneal and conjunctival epithelia without adherence[79].

Secretory mucins act as a "cleaning crew," moving through the tear fluid and collecting debris that can then be removed via the nasolacrimal duct during blinking. The secreted mucins are classified as either gel-forming or soluble. The large gel-forming mucins are probably the largest glycoproteins known based on their high molecular weight and are considered gel forming because they are responsible for the rheological properties of mucus.

The small soluble mucins lack cysteine-rich D domains and are present as monomeric species.

Aqueous Layer

The middle aqueous layer of the tear film consists of water, electrolytes, proteins, peptide growth factors, immunoglobulins, cytokines, vitamins, antimicrobials, and hormones secreted by the lacrimal glands

The normal tear film has numerous constituents,

Tear Constituents: Water,Electrolytes, Na+, K+, Mg2+, Ca2+, Cl- HCO3,PO4,Proteins, Albumin, β-Lysin, Ceruloplasmin, Complement, Lysozyme, Matrix metalloproteinases, Plasminogen activator, Prostaglandins,Proteases, Transferrin, Peptide growth factors

Epidermal growth factor (EGF), Hepatocyte growth factor (HGF)[80]

Lipid Layer

The anterior layer of the tear film is composed of meibomian oil secreted by the meibomian glands and is the major barrier to evaporation from the ocular surface. The lipid layer is also responsible for providing stability to the tear film through interaction with the aqueous-mucin phase, providing a smooth optical surface for the cornea, and acting as a barrier against foreign particles.

A normal tear film lipid layer is able to reduce evaporation by approximately 90% to 95%. The rate of evaporation is affected by the thickness of the lipid layer, and it has been postulated that a decrease in thickness may cause evaporative dry eye[81].

Lacrimal Functional Unit

The lacrimal functional unit is composed of the ocular surface tissues (cornea and conjunctiva, including goblet cells and meibomian glands), the lacrimal glands (main and accessory [Wolfring and Krause]), and their interconnecting sensory (CN V) and autonomic (CN VII) innervation.

Tear film secretion from the lacrimal functional unit is reflexive.The cornea has 60 times more nerve endings than dental pulp.

Goblet Cells

In addition to the epithelial cells, goblet cells are the second cell type found in the conjunctival epithelium and are the main source of mucus secretion. Found singly or in clusters, goblet cells are interspersed among the stratified squamous cells of the conjunctival epithelium.

Meibomian Glands

Human meibomian glands are embedded in the tarsal plate with 20 to 25 and 30 to 40 individual glands present in a single row along the lower and upper eyelid, respectively. Meibomian glands are holocrine glands that discharge the entire content of their acinar cells in the process of secretion. Multiple acini comprise the meibomian gland, and it is these cells that are responsible for synthesizing the meibomian gland lipids, both polar and nonpolar, that are excreted as meibum onto the ocular surface. Meibomian gland function is subject to vascular, neuronal, and hormonal influences.

Lacrimal Puncta

The puncta lacrimalia are oval or circular in shape, about 0.25 mm to 0.30 mm in diameter, and are placed on the lacrimal papillae, a slight elevation which becomes prominent in old age. The puncta of both upper and lower eyelid are situated at the junction of ciliary and lacrimal portion of lid margin, lower one more lateral than the upper and lower one larger than upper. Upper puncta is 6 mm and lower puncta is 6.5 mm from medial canthus respectively. Both are normally turned towards bulbar conjunctiva such that they are in contact with tear lake and surrounded by dense connective tissue which keeps them patent to produce capillary attraction.1,8 As the orbicularis contracts, it draws the puncta 2-3 mm to the medial canthus and with each blink they do not overlap each other but slide in the groove between plica semilunaris and eyeball.

Lacrimal Canaliculi

The canaliculi which average 0.5 to 2.0 mm in diameter and 10-12 mm in length, join the puncta with the lacrimal sac. The canaliculi pass from the puncta 2 mm vertically to the ampulla, a dilated part at the junction of the vertical and horizontal part of each canaliculus. The horizontal part travel 8 mm to the lacrima sac.

Two canaliculi pierce the periorbita (lacrimal fascia) and in 90% of patients, unite to form the common canaliculus (internal common punctum) 2 to 5 mm before entering the lacrimal sac. The canaliculi enter separately in the remaining 10% of cases. Occasionally, the canaliculi pass separately into a diverticulum of the sac, “the sinus of Maier”. The common canaliculi enter the lacrimal sac on the postero-superior portion of its lateral wall 2 to 3 mm below its apex (fundus). At medial canthus, the

medial third of each canaliculus passes behind the medial canthal tendon and common canaliculus lies directly beneath the central portion of the medial canthal tendon.

Canalicular opening is guarded by a fold of mucosa known as Rosenmuller's valve. Traditionally, this structure has been described to prevent reflux of tears from sac back into canaliculi with operation of tear pump. With total nasolacrimal duct obstruction, the retained mucoid or purulent contents of the sac may cause lacrimal sac distension. External massage may cause contents to reflux through an incompetent valve of Rosenmuller and through the canalicular system onto the surface of the eye.

Frequently, edema, inflammation, or distortion of the pericanalicular area may cause the valve to lock, preventing manual expression of the contents of sac and allowing the build up of pressure in the sac with resultant pain in acute dacryocystitis. However recent study explains a bend from posterior to anterior direction behind medial canthal tendon in common canaliculus instead of a mucosal fold in common canaliculus and expansion of sac with infection causes kinking which functionally blocks canaliculus-sac junction.

Closer to the lid (distally) the canaliculi are enveloped by muscle of Riolan. Near the medial canthus (more proximally) the canaliculi are encompassed by portions of pretarsal orbicularis muscle. These pretarsal fibers gradually wrap around to the posterior surface of the canaliculi where they join the fibers from the muscle of Riolan at the position of common canaliculus. This union forms Horner-Duverney's muscle, which remains in close contact with lacrimal drainage system, inserting onto the posterior lacrimal crest and lacrimal sac.

Histology, canaliculi have a non-keratinized stratified squamous epithelium surrounded by dense, collagenous connective tissue that helps to maintain resiliency of the apparatus.

Lacrimal sac

Location: It lies within the lacrimal sac fossa a bony depression at the infero-medial orbital rim outside the medial insertions of orbital septum (extra orbital structure).

Lacrimal fossa is bounded by anterior and posterior lacrimal crests. Anterior lacrimal crest formed by thick frontal process of maxilla continuous with the infra-orbital rim and posterior lacrimal crest formed by thin lacrimal bone is continuous with supero medial orbital rim. Lacrimal fossa is formed by lacrimal bone posteriorly and frontal

process of maxilla anteriorly. Oriented vertically through the middle of lacrimal fossa runs the lacrimomaxillary suture. Ethmoidal sinus air cells pneumatize the lacrimal bone and extend anteriorly into the region of lacrimal sac fossa in approximately 93% of orbits, thereby making bone thin and facilitating DCR. In some patients, large ethmoid air cells may extend under the entire lacrimal fossa, wherein the lacrimal surgeon may fail to distinguish thin, friable gray ethmoid air cell mucosa from thicker, pink nasal mucosa. A small sulcus in the maxillary bone lies 1 to 2 mm anterior to anterior lacrimal crest and is referred to as the suture notha or false suture, which is a good landmark for identifying the anterior lacrimal crest.

Lacrimal fascia (Diaphragm): Lacrimal sac is coverd by lacrimal fascia, which is a part of periorbita. Periorbita (periosteum lining orbita) splits at posterior lacrimal crest into two layers to enclose sac and again meet at anterior lacrimal crest. Between the lacrimal sac and fascia lie alveolar tissue and venous plexus which is continuous around the nasolacrimal duct.

Lacrimal sac proper

Length - 12-15 mm

Breadth (anteroposterior) - 5-6 mm

Volume - 20 Cmm

It has got three parts

Fundus – portion above opening of canaliculi (2-3 mm)

Body -- middle part (10-12 mm)

Neck (Isthmus) – Lower small part continuous with NLD.

Fundus of sac which extends above MPL (Medial Palpebral Ligament) is covered by tough fibers. So lacrimal sac distensions and lacrimal cutaneous fistulas occur below MPL. Any sac distension above MPL suggests a neoplasm of sac rather than infection.

Relations of the lacrimal sac

Medially: Anterior ethmoidal sinus in the upper part and middle meatus of nose in lower part.

Anterolateral relations of the sac (from deep to superficial)

• Lacrimal fascia and few fibers of the inferior oblique muscle which arise from it.

• Lacrimal fibers of the orbicularis muscle (Horner's muscle).

• Medial palpebral ligament, which covers only the upper part of the sac.

• Palpebral fibers of orbicularis.

• Angular vein which crosses the medial palpebral ligament 8 mm from medial canthus. Many a time a tributary of angular vein runs between it and the medial canthus. Therefore, to avoid profuse bleeding during sac surgery the incision should not be made more than 3 mm medial to medial canthus.

• Skin is the most anterior relation of the lacrimal sac.

Posteriorly from anterior to posterior important structures are:

• Lacrimal fascia

• Fibres of lacrimal part of orbicularis

• Septum orbitale which separates the sac from orbital fat and check ligament of medial rectus muscle.

The Nasolacrimal Duct (NLD)

It extends from neck of lacrimal sac to its opening in the inferior meatus of the nose. It is about 18 mm (may vary from 12-24 mm) in length and about 3 mm in diameter. The upper end of the NLD is its narrowest part. Direction of Naso Lacrimal Duct is downwards, backwards and laterally. Its location can be represented on surface by a line joining inner canthus with ala of nose.

NLD consists of two parts: an intraosseous part (12.5 mm) and intrameatal part (5.5 mm). The intra-osseous part lies in the bony naso-lacrimal canal which is formed anterolaterally by maxilla and posteromedially by lacrimal and inferior nasal concha. The nasolacrimal canal lies lateral to middle meatus and produces a ridge in maxillary antrum; therefore, lesions of maxillary sinus often cause epiphora.

Intrameatal part of NLD lies within the mucous membrane of lateral wall of the nose. The opening of the NLD in the inferior meatus is situated at a depth of about 30-40 mm from anterior nares.

The lumen of NLD is marked by numerous folds of mucous membrane, the so-called valves. Of these most consistent and important one is valve of Hasner situated at its lower end. It prevents entry of air into lacrimal sac, when air is blown out of closed nose.

In fetus NLD is a solid cord of cells, which gets canalized later. In 30% infant's canalization is delayed and does not occur at its lower and near valve of Hasner causing NLD blockage epiphora leading onto congenital dacryocystitis.

Histological Structure of sac and NLD

- Epithelium – Lacrimal sac and NLD are lined by two layers of cells. Superficial layer is non-ciliated columnar cells and contains goblet cells.
- Sub-epithelial tissue contains lymphocytes which may aggregate in pathological conditions to form follicles.
- Fibro-elastic tissue of lacrimal sac becomes continuous with that of canaliculi.
- Plexus of vessels is well developed around NLD, an erectile tissue resembling that of inferior concha. Engorgement of these vessels is sufficient to cause obstruction of NLD and cause epiphora.

Research Updates

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2. Amit swarnakar et.al "Concept of Srotas from Ayurvedic Perspective with special reference to neurology" IJMSCR,Vol 2,issue 1,Jan-March2014,36-43
3. K. Sreekumar Ayurvedic concept of neural mechanism of the lacrimal functional unit and its disruption International Journal of Applied Ayurved Research ISSN: 2347- 6362. VOLUME III ISSUE 1 MAR-APR 2017
4. Sanjay A Dalvi " Scientific aspects of Sushruta Netra Sharir in context to Modern ophthalmic anatomy" Journal of Biological and Scientific Opinion Vol 3(6) 2015,284-286
5. C. K. Ramachandran "NIMI TANTRA (Opthalmology of Ancient India)" Ancient Science of Life, Vol No. III No.4 April 1984, Pages 183 - 187.

MATERIAL AND METHODS

Study design – Observational study

Study was carried out in following steps,

I. Conceptual study
II. Cadaveric study
III. Clinical Observational study

I. Conceptual study

The Review of Literature performed by formulation of search keys as follows,

1. Literary study: Classical texts like Charaka, Susruta Ashtanga Sangraha, Ashtanga Hrudaya Samhita and all relevant classics of Ayurveda. Vedas, Upanishads, Puranas and allied literature. Relevant modern texts, Periodicals, journals, monographs, internet materials.

II. Cadaveric study: 5 cadavers

III. Clinical Observational study

Place of Study

- **Cadaveric Study :** The cadaveric study was carried out at Department of Shareera Rachana, SDM Institute of Ayurveda and Hospital, Bengaluru, Karnataka
- **Clinical Observational study :** The Clinical Observational Study was carried out at SDM Institute of Ayurveda and Hospital, Bengaluru,Karnataka

Methodology

1. **Cadaveric Dissection-**

Method of sampling: Convenient sampling method

Sample size: 5

Part: Cadaver's head

Sections: Sagittally sectioned specimens. Preserved in10% formaldehyde solution

A case proforma was prepared for dissection point of view as per Cunnigham manual and methodology from recent research works were adopted and observations were noted. Based on observations the structures related to Ashruvaha Srotas were defined.

Dissection Methodology

- Head sections (sagitally sectioned) of 5 cadaver's (5 right and 5 left) were taken for the study which were preserved in 10% formaldehyde solution.
- Next lacrimal apparatus and related structures was dissected on both right and left side of sagittal section.
- The middle turbinate was retracted superiorly and the maxillary line was traced.
- The distances on dissection between various landmarks in Lacrimal apparatus was measured by digital calipers.
- Soon after of the retraction, an incision was made with mucosa and periosteum. Lacrimomaxillary suture was traced and exposed by elevating the mucosa and periosteum.
- Dissection was carried on nasolacrimal duct and lacrimal sac by removing lacrimal bone (which is posterior to the lacrimomaxillary suture) and the frontal process of maxilla (which is anterior to the lacrimomaxillary suture)
- Relation of lacrimal sac and lacrimal bone was noted.
- The agger nasi were noted and its excised to expose nasolacrimal sac.
- The uncinate process was removed to reveal maxillary sinus ostium and a part of inferior turbinate was dissected and excised to expose nasolacrimal duct.
- Then the dimensions and features/landmarks on cadaveric dissection were determined with the digital callipers in the format prepared for this study.
- The features and landmarks were noted and tried to correlate and interpret with the terms of ashruvaha srotas

Statistical Analysis

For statistical analysis SPSS (ver 16) was used. Calculation of Mean, standard deviation and the minimum and maximum values of all measurements were determined with help of software; to know the significant statistical difference between right and left side "paired t" test was applied.

2. Clinical Observational study

Method of sampling: Convenient sampling method

Sample size: 100 cases of Netra srava

The clinical Observational study was carried out as mentioned below,

1. Pilot study
2. Main study

Pilot Study: Sample size: 30 cases

The clinical observational Pilot study was carried out among 30 subjects and the observations were analyzed with the statistical test by using SPSS 16.

Source: The study was carried out at SDM Institute of Ayurveda and Hospital, Bengaluru and approval was obtained for conducting the observational study (Approval number –SDM /IEC/90/2015-2016)

Study design: Observational study

- Initially 8 cases were taken as per the case proforma submitted in the synopsis to check for criteria in the study.
- During this study as per the guidelines of the Subject experts various gradings and some points were included in the case proformoa like Shiemers test, tear break up time etc.
- According to the modified proforma cases of pilot study was done.
- The data of pilot study was taken and analyzed and further main study started.

Main Study:

For observational study 100 cases of Netra srava were taken by convenient sampling method. Netra Srava was assessed with help of subjective and objective parameters. Systematic eye examination was done. The root of pathology and Structures involved in the same were identified. Analysis of samprapti involved in srava were substantiated with the help of subjective and objective findings in eye examination. After analysing the samprapti and the structural entities involved in it an effort was made to correlate and reconstruct the various terminologies with the parts of ashruvaha srotas.

Assessment Criteria

Subjective criteria

1. Epiphora
2. Swelling
3. Redness
4. Discharge watery/mucoid/purulent

Objective criteria

1. Size and position of punctum
2. Regurgiitation test
3. Lacrimal syringing
4. Dye disappearance test
2. Dacrocystogram(as per necessity)

Inclusion criteria:

1. Patients suffering from srava having the Clinical features mentioned as per classics
2. Diseases of lacrimal passage
3. Age group of 10-60 years irrespective of gender

Exclusion criteria:

1. Craniofascial anomaly
2. History of trauma
3. Acute dacrocystities

Methodology:

A detailed history was taken in each case, followed by thorough general and systemic examination and ocular examination as per the proforma attached subsequently.

Investigations of Lacrimal Passages

1. **Slit lamp examination** - In this examination subject is to sit in a chair with the instrument placed in front. Tell patient to keep chin and forehead on a support to keep head steady. By this slit lamp examination we can have to examine eyelids, cornea, conjunctiva, sclera, and iris. Most of the time a yellow dye (fluorescein) is used to help examine the cornea and tear layer.
2. **Schirmer's Test -1**: The patient was seated comfortably in a dimly light room in chair with head straight. We have to use No.41 Whatman filter paper strips having 5mm wide and 30mm long partially folded 5mm from one end at 90^{o}. The folded short end was gently placed in the lower conjunctival fornix at the junction of middle and lateral one-third of lower lid and the patient was told to look straight ahead and to keep eyes open. If patients want to blink, it was allowed. At the end of the five minutes, the strips were removed and two minutes later the amount of wetting of the strips from the folded ends was measured with a millimeter scale. If

tear fluid failed to diffuse over the lid margin along the strip within 2 minutes, it was moved to another site within the sac and time was recorded. The Schirmer's test was used to determine the quantitative tear formation. Normal range is wetting of 10 to 25 mm. Below 10 mm and upto 5 mm it is border line and less than 5mm wetting definitely abnormal.

3. **Tear film Break up Time Test:** Tear film B.U.T. was used to measure the quality of the tear film. A moistened fluorescein strip was applied to the inferior temporal bulbar conjunctiva. Patients were instructed to blink several times to facilitate an even distribution of fluorescein. Then patient was send for slit lamp examination and asked to stare directly ahead without blinking or holding the lids after one complete blink. The tear film was then scanned through a cobalt blue filtered light by magnification and broad vertical beam. A stopwatch was used to measure the interval between the last complete blink and the first appearance of a randomly distributed dry spot, the tear film B.U.T. Three consecutive readings were taken in each eye and the mean value of these readings were considered above 10 seconds as normal and less than 10 seconds as cases of dry eyes.
4. Sac syringing:
    - Patient is made to lie down examination table at 45 degree or is made to sit on the chair with a proper lighting.
    - Flush is done with the help of Nettleship dilator by drawing 2 ml of saline into syringe and attaching cannula.
    - Give local anesthetic eye drops into eyes and directly over punctum and should be wait for 30 seconds.
    - After 30 seconds insert a Nettleship dilator into the lower punctum, follow the direction of the lower canaliculus (which is vertically downward for the first 2mm)
    - With the help of fingers gently rotate the dilator in to clockwise/anticlockwise.
    - After the first 2mm of vertical insertion, move slight lateral traction on the lower lid to straighten the ampulla of the lower canaliculus and then continue to gently insert the dilator but in a more horizontal direction nasally to continue following the direction of the canaliculus.

- At lower punctum insert the cannula, Again, apply slight lateral traction to the lower lid as the cannula is inserted along the canaliculus.
- Insert the cannula till a "stop" is reached
- If stop is soft (spongy) or hard (bony) Withdraw the cannula 2mm from the stop point and slowly inject fluid.
- Explain to the patient that may have the sensation of a salty taste at the back of the mouth and to notify you when this occurs.
- Assess the ease/resistance of the fluid flush and look at the upper punctum to assess for regurgitation. If the patient is not aware of a salty fluid sensation in the throat, it indicates a blockage somewhere in the lacrimal apparatus. The fluid may be seen coming through the upper punctum.
- If the patient feels tastes salty water in mout we should think the lacrimal drainage system is patent under test conditions i.e. high pressure. This does not exclude "functional" duct obstruction.
- If the patient cannot taste salty water we should think the lacrimal drainage system is blocked.
- At the level of blockage how is the "stop" (Hard/Soft) on these basis following can be ruled out,
- Hard stop: - the blockage is likely in the nasolacrimal duct.
- Soft stop: blockage is within the canalicular system. If there is regurgitation from the upper punctum it suggests a blockage in the common canaliculus while if there is no regurgitation from the upper punctum it suggests a blockage in the lower canaliculus.

5. **Regurgitation** on Pressure over Lacrimal Sac Area (ROPLAS). Palpation with pressure on a distended lacrimal sac may cause reflux of mucoid or mucopurulent material through canalicular system if the common canaliculus and valve of Rosenmuller are patent. Reflux of mucoid or mucopurulent discharge confirms complete nasolacrimal duct obstruction.
6. **Diagnostic probing** of upper system (puncta, canaliculi, lacrimal sac) is useful in confirming site of obstruction in lacrimal system. It is performed under topical anaesthesia, A small probe (0000) should be used preliminarily to determine canalicular obstruction

7. **Fluorescein Dye Disappearance Test** (DDT) is useful for know the presence or absence of lacrimal outflow, this test specially helps to identify the block in unilateral cases. Fluorescein is instilled in the conjunctival fornices of each eye of the patient in sitting position and looking straight ahead. The tear film is observed for five minutes. Asymmetrical clearance of the dye from the tear meniscus indicates a relative obstruction on the side retaining the dye. The examiner makes a subjective assessment of how much dye is remaining by noting the colour intensity and grading done from 0+ to 4+.(0+ . . . +1 . . . Normal; +2 . . . +4 Inadequate drainage) . This test indicates obstruction at any level, from eyelid malposition or poor lacrimal pump or punctual stenosis or canalicular obstruction or NLD obstruction. Addition testing is necessary to locate the exact pathology.
8. **Nasal Examination**: Anterior nasal examination is done with the help of speculum or a nasal endoscopy. It is important to assess the mucosal health and presence of pathologic process that may be responsible for intranasal obstruction of a nasolacrimal duct. Also it helps to confirm enough space available in nasal passageway for any possible nasolacrimal procedure. A severely deviated nasal septum may put pressure on inferior turbinate obstructing drainage through NLD. Also a hypertrophied middle turbinate is to be addressed before DCR as this may block nasal opening of iatrogenic naso-lacrimal fistula.

Statistical analysis: The data obtained during the study will be tabulated and analyzed statistically using descriptive statistics.

ANALYSIS AND INTERPRETATION

Cadaveric Study

Five adult cadaver's head sections (5 right and 5 left, n=10) fixed with 10% Formaldehyde solution were dissected and studied. Cadavers were excluded if there was anatomical damage to the structures related to eye.

Observation of cadaver Dissection

- After dissecting and exposing both the right and left orbital part, blunt dissection was done to expose the sac in lacrimal fossa.
- The lacrimal gland was found to be placed in superiolateral aspect of the orbit on elevating the superior rectus and lateral rectus muscles. As the lacrimal gland was embedded in the fossa with its attachment, it was carefully separated and approximate measurement was taken as 19x12x4mm (average measurement of 5 cadaver lacrimal gland).
- During the dissection of the lacrimal gland, the lateral horn of aponeurosis of levetor palpebrae muscle was seen separating the two lobes of lacrimal gland as orbital lobe and palpebral lobe. The orbital lobe was seen posterior and superior aspect to this aponeurosis and the palpebral lobe was identified in anterior aspect and inferior to it.
- On dissecting further parts of lacrimal apparatus, it was observed that the maxillary line was seen externally corresponding to the lacrimo maxillary suture along lateral wall of the nose , which was the mucosal projection. It extended from the anterior attachment of middle turbinate to the base of inferior turbinate and this line was seen dividing the lacrimal sac.
- The lacrimal sac initial part of nasolacrimal duct is in the inferior part of the fossa, the nasolacrimal canal is formed anteriolaterally.
- A point in the mid portion was seen which is mentioned as M point. The M point will be 3.9 cm from the nasal sill in women and 4.8 cm in men.

Table no- 9: The cadaveric study was computed in following headings

Sl No	**Point of dissection**	**Measurement/observation (Length is in mm)**
1.	Maxillary line	Clear/ not clear
2.	Maxillary line length-	axilla to inferior turbinate (in mm);
3.	Midpoint of maxillary line	Anterior nasal spine to M point -in mm
4.	Relation of	Lacrimomaxillary suture line to maxillary line
5.	Thickness of lacrimal bone (in mm)	
6.	Position Lacrimal sac (After removal of lacrimal bone)	Lacrimal sac seen (less than half, more than half/ not seen)
7.	Position Superior end of sac with axilla	at / below/ above axilla
8.	diameter of lacrimal sac	Anteroposteriorly
9.	Length of lacrimal sac	in mm
10.	The relation between	The lacrimal sac and the maxillary line
11.	Relation of	anterior point of middle turbinate to nasolacrimal duct: (at/anterior/posterior)
12.	Length of the nasolacrimal Duct	Calculated from the area between the sac and duct up to the intranasal orifice

Table no 10: Visibility of Maxillary line

Maxillary line	**Clear**	**Not clear**
Right(n=5)	4	1
Left(n=5)	3	2
Total(n=10)	7(70%)	3(30%)

In this study, Maxillary line was found to be visible in 7(70%) cases and not clearly visible in 3(30%) cases.

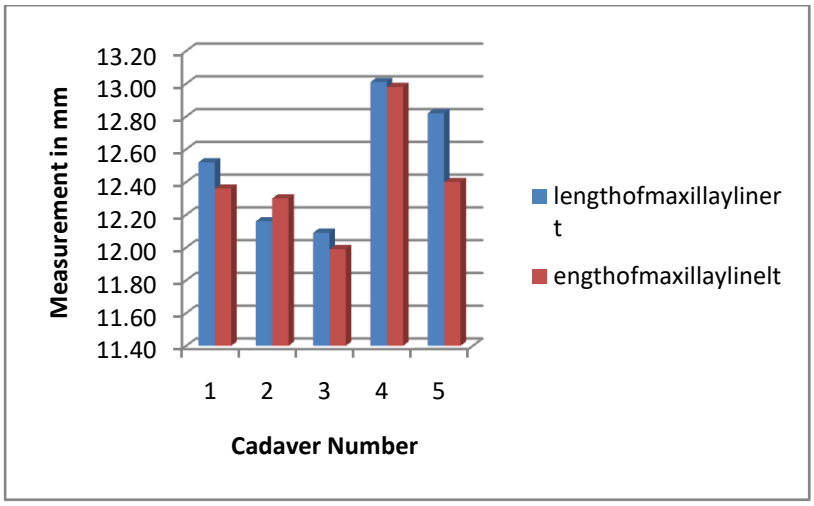
Clinical Application/Anatomy: This maxillary line plays an important role in clinical aspect, in the treatment of diseases related to lacrimal apparatus. The maxillary line and M-point are very important in the endoscopic sinus and orbital procedures and serves as a useful landmark during endoscopic dacryocystorhinostomy.

Table 11: Length of Maxillary line (from Axilla to inferior turbinate -in mm)

	Length (S.D)	**Range**	**P value**
Right(n=5)	12.52 (0.401)	12.09 -13.01	0.61
Left(n=5)	12.41 (0.359)	11.99 -12.98	
Total(n=10)	12.46 (0.38)	11.99 -13.01	

Pearson Correlation - 0.861, Correlation is not significant at the 0.01 level (2-tailed).

Graph No 1 : Length of Maxillary line length- from axilla to inferior turbinate (in mm)



In this study Maxillary line length was calculated from Axilla to the inferior turbinate and it was found that mean length was 12.46 mm with a range between 12.09 -13.01 mm. The M point formed the landmark for the lacrimal sac and nasolacrimal duct junction anteriorly and posteriorly superior aspect of maxillary sinus ostium.

The mean (SD) length of maxillary line was measured as 12.54 (2.49) mm (range, 8.09-16.79 mm). In our study we also noted that M point marks the level of superior aspect of the maxillary sinus ostium posteriorly, and the junction of the lacrimal sac and the nasolacrimal duct anteriorly in all cadavers

Table 12: Distance between Anterior nasal spine to M point (midpoint of maxillary line)-in mm

Side	**Distance Mean (SD)**	**Range**	**P –value**
Right(n=5)	29.77(0.349)	29.28 – 30.26	0.080
Left(n=5)	29.87(0.366)	29.23 -30.11	
Total(n=10)	29.82(0.357)	29.23 -30.26	

The Distance between Anterior nasal spine to M point which is called as mid point of maxillary line and it found to be mean of 29.82.

Pearson Correlation - 0.832, Correlation is not significant at the 0.01 level (2-tailed).

Graph No 2: Anterior nasal spine to M point (midpoint of maxillary line)-in mm

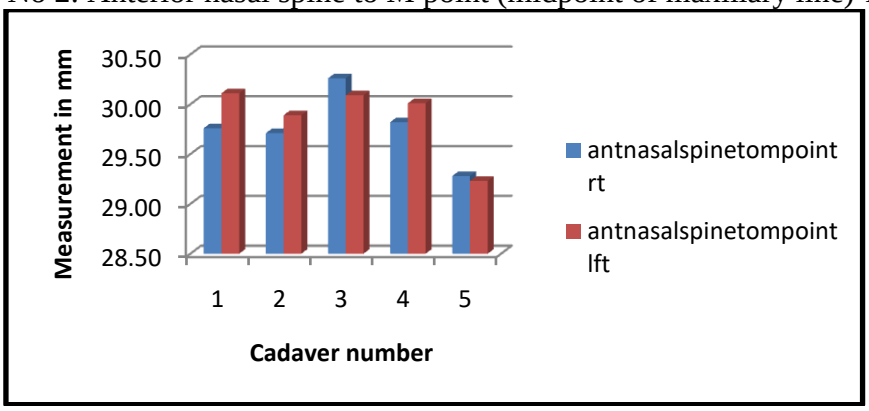


Table 13: Relation of lacrimomaxillary suture line to maxillary line

	Relation (anterior/posterior/over)		
Side	**Relation-anterior**	**Posterior**	**Over**
Right(n=5)	1	3	1
Left(n=5)	3	1	1
Total(n=10)	4	4	2

In front of maxillary line, Lacrimomaxillary suture was seen in 4(40%). This suture seen posterior to maxillary line in 4(40%) cases and over maxillary line in 2(20%) specimens

Table 14: Thickness of lacrimal bone (in mm)

Side	**Thickness (dissection) Mean (SD)**	**Range**	**p-value**
Right(n=5)	0.24 (0.011)	0.23 - 0.26	0.170
Left(n=5)	0.25 (0.005)	0.24 - 0.25	
Total(n=10)	0.24	0.23 -0.26	

Pearson Correlation – 0.721

Correlation is not significant at the 0.01 level (2-tailed).

Clinical anatomy: In Asian patients, the frontal process of the maxilla is very thick compared to other studies. Surgical drills may be required for the Asian patient to expose the upper portion of the sac fossa.

Graph No 3: Thickness of lacrimal bone (in mm)

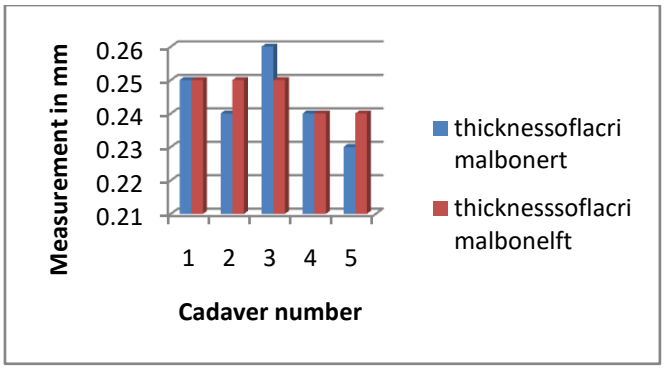


Table 15: Position of lacrimal sac seen, after removal Lacrimal of al bone (less than half, more than half/ not seen)

Side	Side	Less than half	More than half
Right(n=5)	**Right**	3	2
Left(n=5)	**Left**	3	2
Total(n=10)	**Total**	6(60%)	4(40%)

The lower part of lacrimal sac was seen less than half in 6(60%) cases and more than half in 4 (40%) after removal of the lacrimal bone.

Table no 16: Position of Superior end of sac is at / below/ above the level of axilla

Side	Above axilla	Below axilla
Right(n=5)	3	2
Left(n=5)	3	2
Total(n=10)	6(60%)	4(40%)

In the total cases, in 6(60%) cases the superior end of sac was above axilla and in 4(40%) it was below the axilla.

Table 17: Lacrimal sac in Anteroposteriorly (in mm)

Side	Distance Mean (SD)	Range	P –value
Right(n=5)	7.54 (0.013)	7.53-7.56	0.890
Left(n=5)	7.33 (0.353)	7.17-7.96	
Total(n=10)	7.43 (0.183)	7.17-7.96	

Pearson Correlation – 0.087, Correlation is not significant at the 0.01 level (2-tailed)

Graph No 4: Anteroposterior diameter of lacrimal sac (in mm)

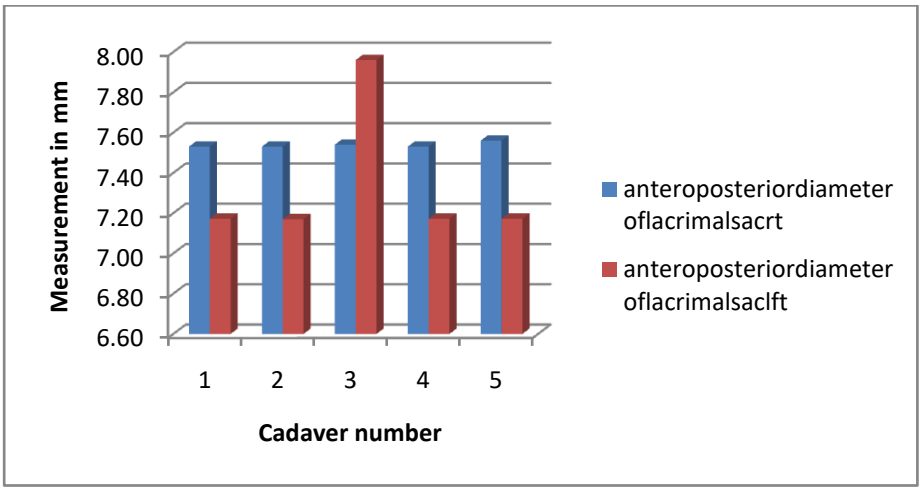


Table 18: Length of lacrimal sac (in mm)

Side	Distance Mean (SD)	Range	P –value
Right(n=5)	11.70(0.263)	11.27 -11.89	0.931
Left(n=5)	12.12(0.085)	11.99 - 12.2	
Total(n=10)	11.91(0.174)	11.27-11.99	

Pearson Correlation – 0.054, Correlation is not significant at the 0.01 level (2-tailed)

Graph No 5: Length of lacrimal sac (in mm)

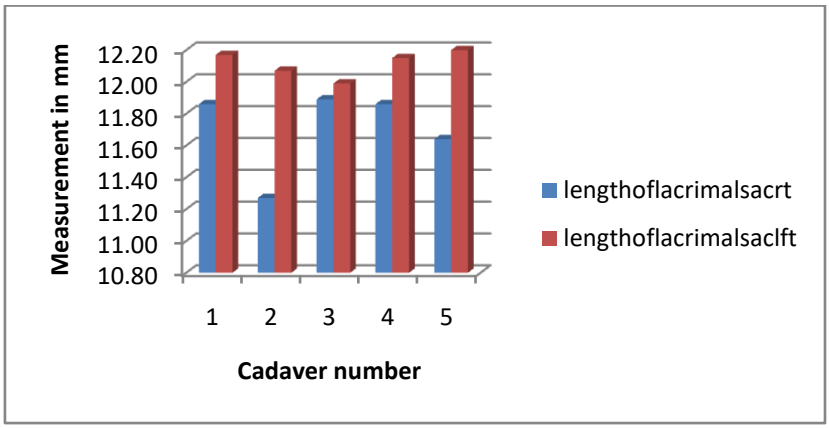


Table 19: The relation between the lacrimal sac and the maxillary line

Side	Relation		
	Less than	More than	Full anterior
Right(n=5)	2	3	-
Left(n=5)	2	3	-
Total(n=10)	4(40%)	6(60%)	-

Lacrimal sac was more than half anterior to maxillary line in 60 % of cases and less than half anterior in 40% of cases

Table 20: Relation of anterior point of middle turbinate to nasolacrimal duct (at/anterior/posterior)

Side	Relation		
	Anterior	Posterior	At
Right	1	3	1
Left	1	3	1
Total	2(20%)	6(60%)	2(20%)

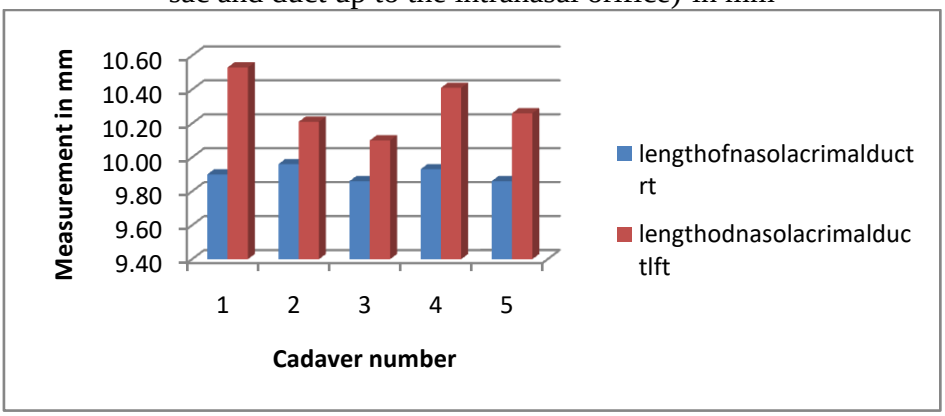
Pearson Correlation – 1.000, P value 0.000, Correlation is significant at the 0.01 level (2-tailed). Middle turbinate genu was found at NLD in 20% of cases and posterior in 60% of cases and anterior in 20% of cases.

Table 21: Length of the nasolacrimal duct (from the transition area between the sac and duct up to the intranasal orifice)-in mm

Side	Distance Mean (SD)	Range	P –value
Right(n=5)	9.90 (0.044)	9.86 -9.96	0.683
Left(n=5)	10.30 (0.169)	10.1 -10.53	
Total(n=10)	10.1(0.10)	9.86 -10.53	

Pearson Correlation – 0.252, Correlation is not significant at the 0.01 level (2-tailed).

Graph No 6: Length of the nasolacrimal duct (from the transition area between the sac and duct up to the intranasal orifice)-in mm



Results of Clinical observational study

Pilot study

The results of Pilot study in 30 subjects are presented as follows,

Table No 22 – Pilot study Result of Clinical Observational study

Parameters		**Prakruti pareeksha**			
		Vata Pradhana	Pitta Pradhana	Kapha Pradhana	Total
Colour of srava (Discharge)	White	10	4	2	16
	Yellow	5	8	1	14
	Total	15	12	3	30
Nature of srava (Discharge)	Thin watery	8	0	2	10
	Purulent	7	10	1	18
	Thick	0	2	0	2
	Total	15	12	3	30
Quantity of srava	Mild	2	2	0	4
	Moderate	13	6	3	22
	Profuse	0	4	0	4
	Total	15	12	3	30
Grading of discharge	Grade 1	5	0	1	6
	Grade 2	3	0	2	5
	Grade 4	7	12	0	19
	Total	15	12	3	30
Position of punctum	Normal	15	12	3	30
	Total	15	12	3	30
Approx size of punctum	Normal	8	2	3	13
	Abnormal	7	10	0	17
	Total	15	12	3	30
Lacrimal sac area	Normal	6	1	2	9
	Abnormal	9	11	1	21
	Total	15	12	3	30
Lacrimal puncta	Normal	11	6	1	18
	Abnormal	4	6	2	12
	Total	15	12	3	30
Functional variation grading	Grade 1	7	4	3	14
	Grade 2	8	8	0	16
	Total	15	12	3	30
Schirmer test1	Normal	8	7	2	17
	Hypersecretion	6	5	1	12
	Dry eye	1	0	0	1
	Total	15	12	3	30
Tear breakup time	0	5	0	1	6
	Normal(more	10	11	2	23
	Deficiency of	0	1	0	1
	Total	15	12	3	30
Block in sac syringing test	Com	9	10	0	19
	Par	6	2	3	11
	Total	15	12	3	30

Regurgitant on sac syringing	Clear	6	0	1	7
	Mucopurulant	9	12	0	21
	Purulant	0	0	2	2
	Total	15	12	3	30
ROPLAS	Clear mucoid/MP	15	12	3	30
	Total	15	12	3	30
Diagnostic probing	Res@3mm	11	3	1	15
	Res@3to8mm	4	9	2	15
	Total	15	12	3	30

Table No 23: Study Population

Sl No	**Gender**	**Number**
1.	Male	09
2.	Female	21
	Total	30

Table no 24: Occupation and socioeconomic status

		Socioeconomic status		Total
		Low	Mid	
Occupation	HW	4	8	12
	work	13	5	18
Total		17	13	30

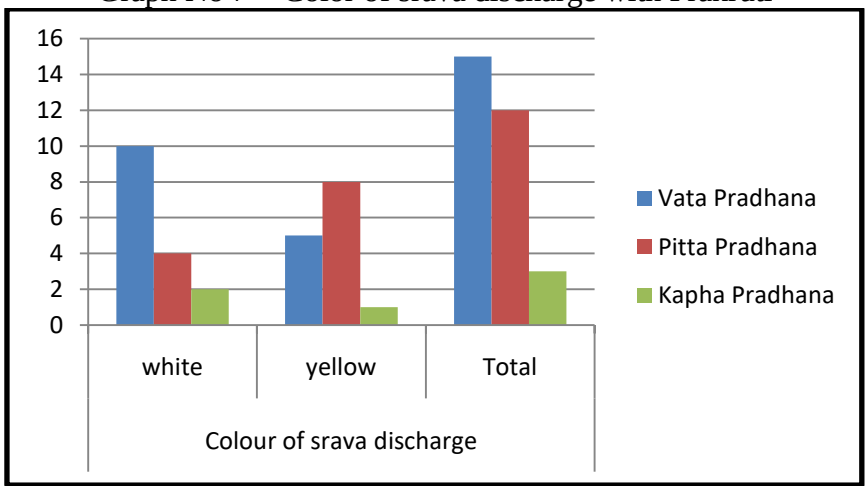
Table no 25: Gender and laterality

Gender		Laterality			Total
		OS	OD	OU	
	Male	3	5	1	9
	Female	4	14	3	21
Total		7	19	4	30

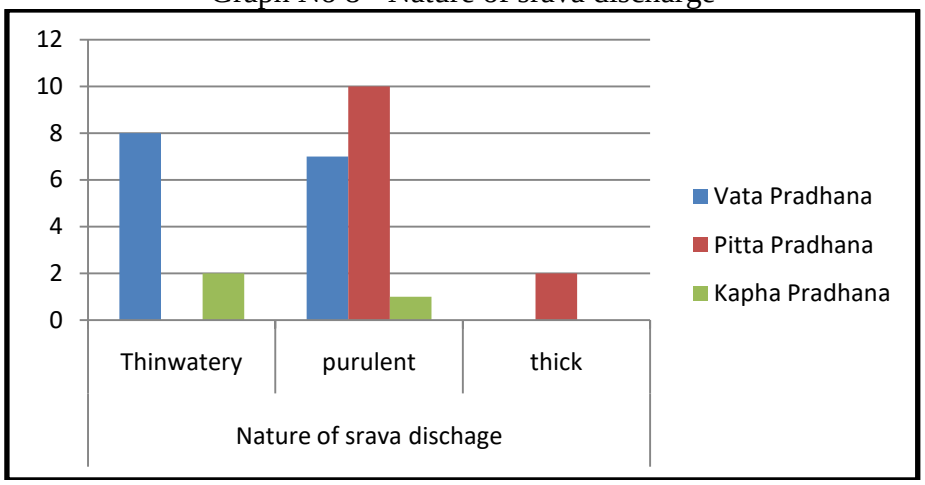
Table no 26: Prakruti pareeksha and presenting complaint

		Presenting complaint				Total
		EP	EP+SW	EP+DIS	EP+SW+DIS	
Prakruti pareeksha	Vatapitta	4	5	2	4	15
	Pittapradhana	3	2	2	5	12
	Kaphapradhana	1	0	1	1	3
Total		8	7	5	10	30

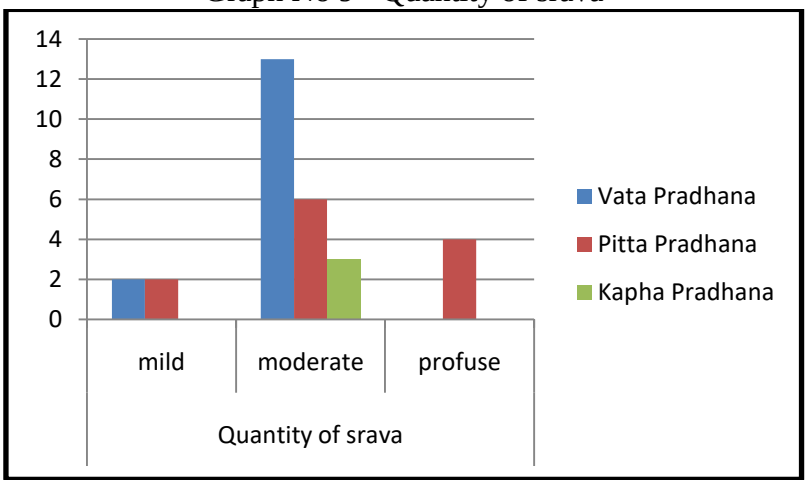
Graph No 7 - Color of srava discharge with Prakruti



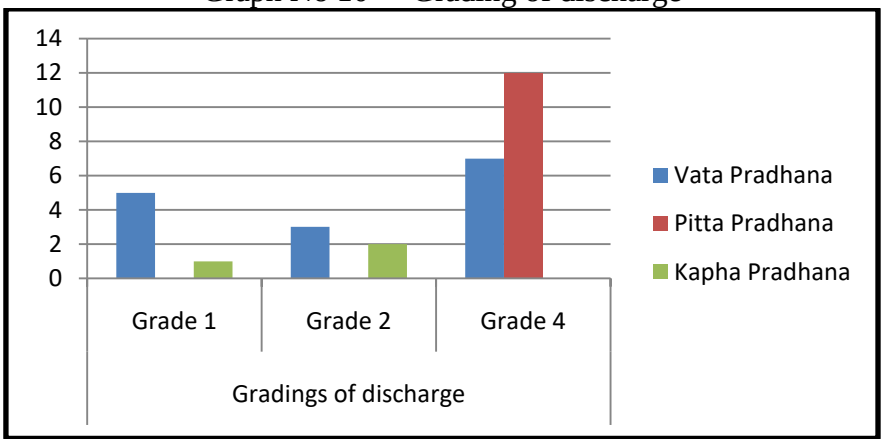
Graph No 8 - Nature of srava discharge



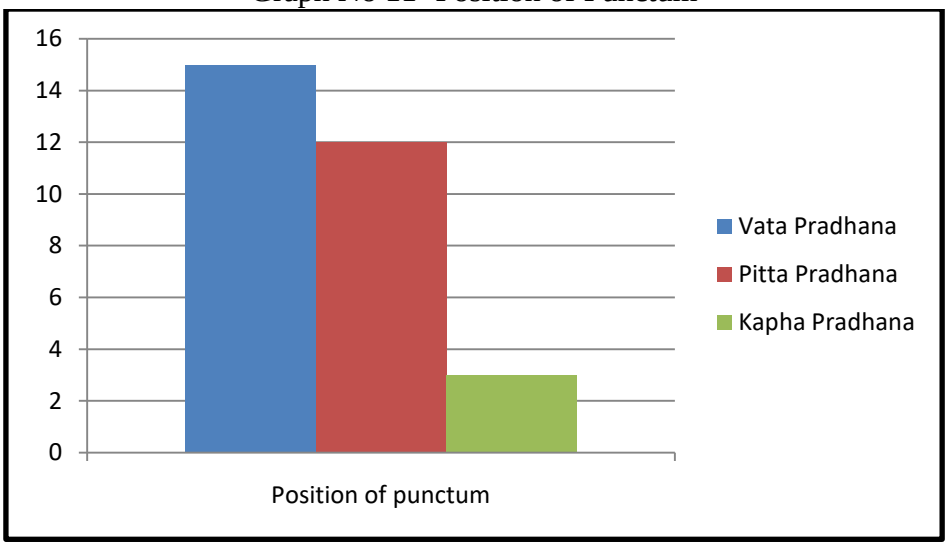
Graph No 9 - Quantity of srava



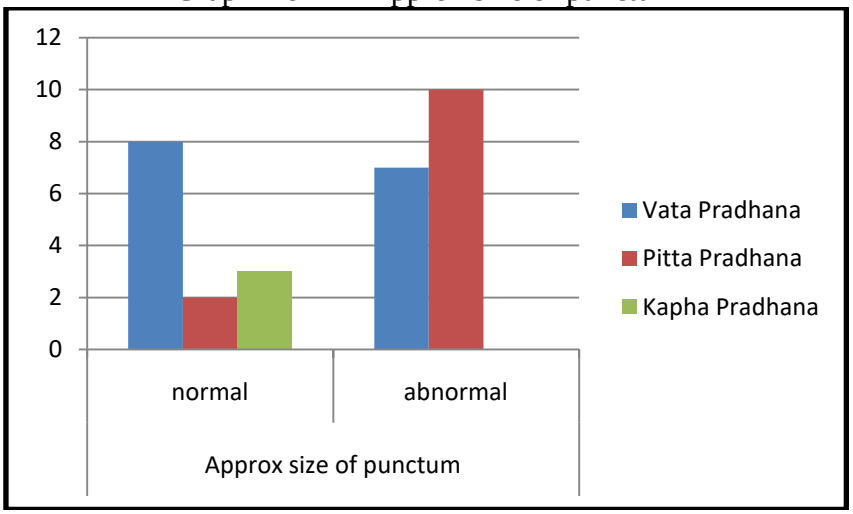
Graph No 10 - Grading of discharge



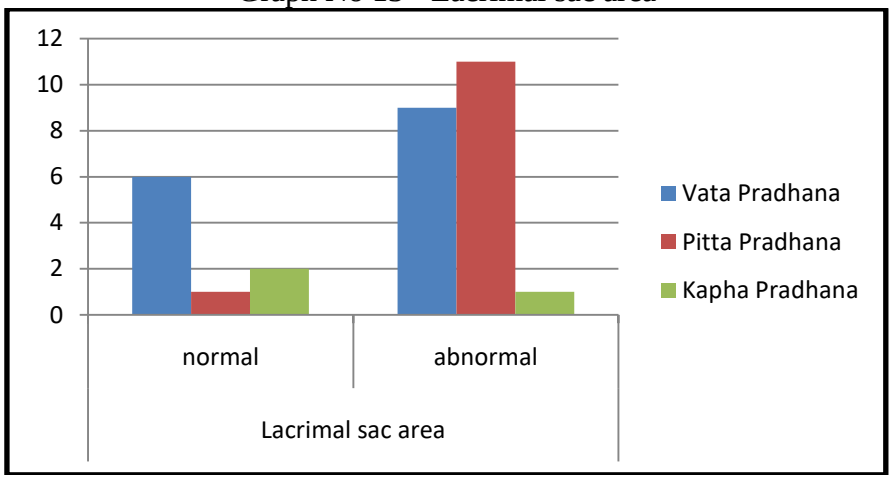
Graph No 11- Position of Punctum



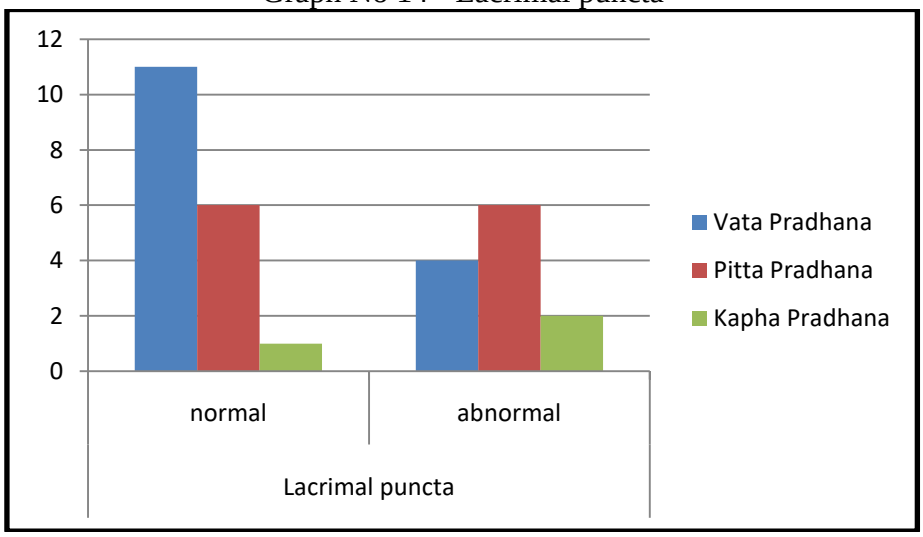
Graph No 12 - Approx size of punctum



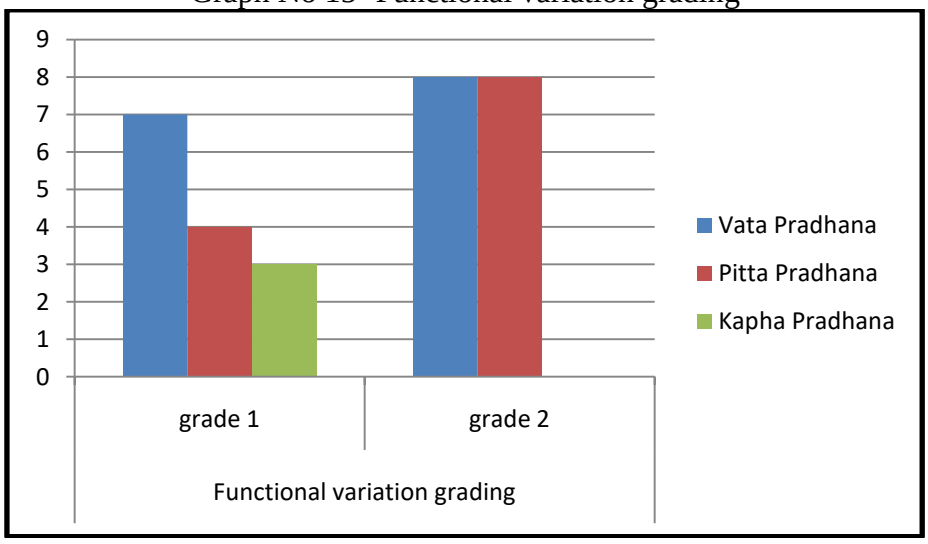
Graph No 13 - Lacrimal sac area



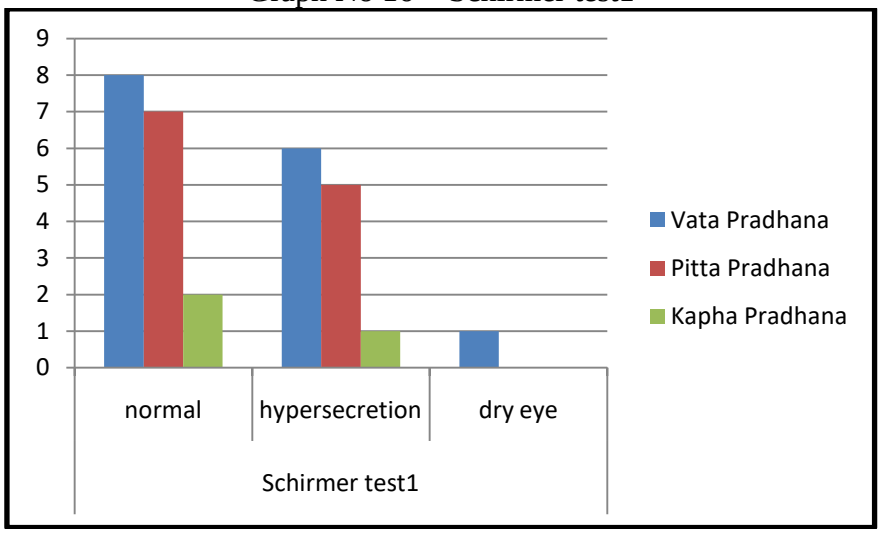
Graph No 14 - Lacrimal puncta



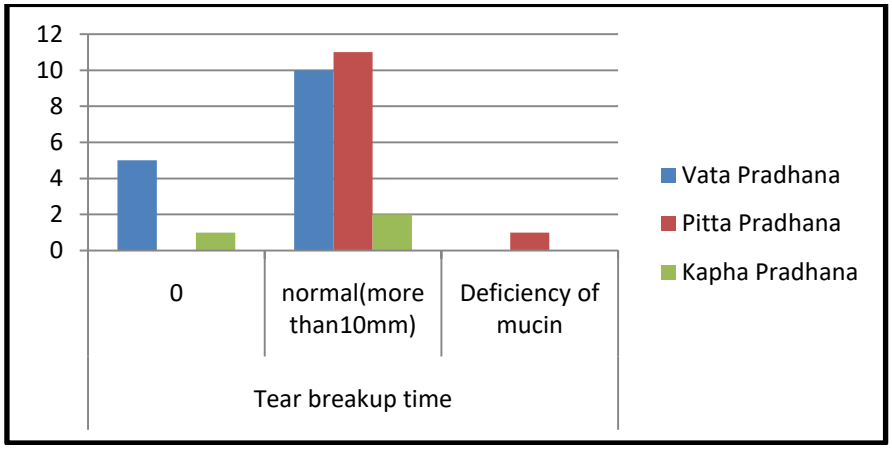
Graph No 15 -Functional variation grading



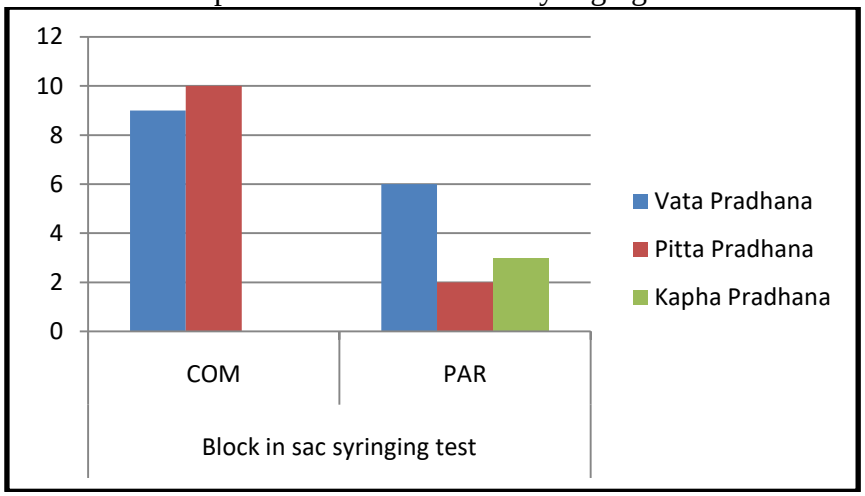
Graph No 16 - Schirmer test1



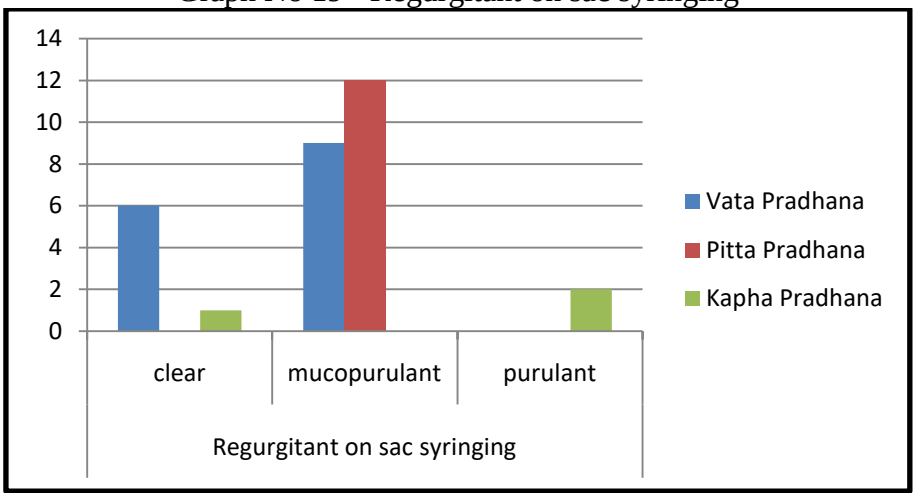
Graph No 17 - Tear breakup time



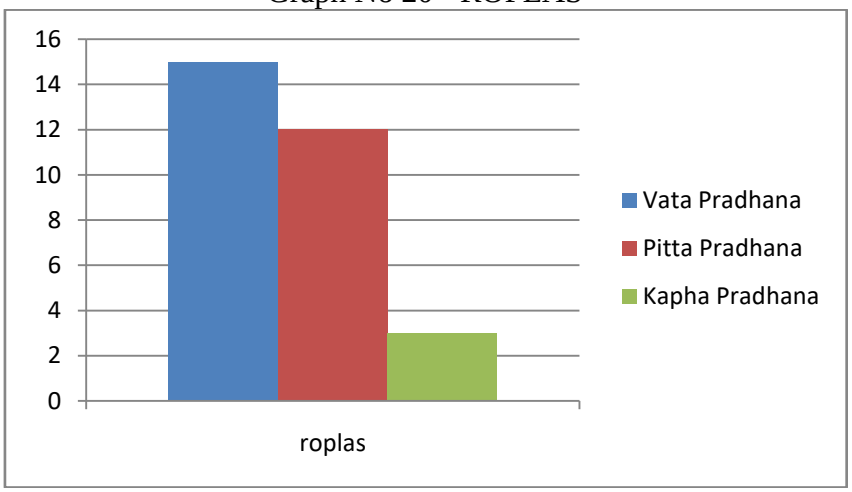
Graph No 18 - Block in sac syringing test



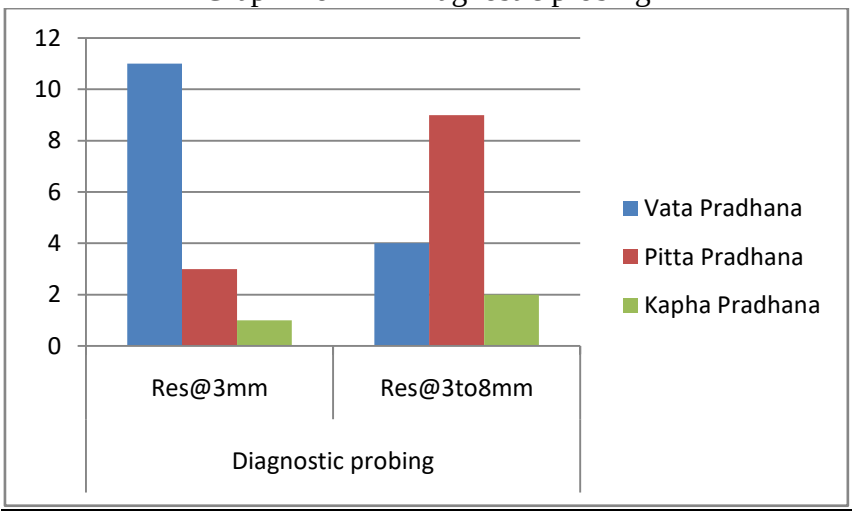
Graph No 19 - Regurgitant on sac syringing



Graph No 20 - ROPLAS



Graph No 21 - Diagnostic probing



Results of Clinical observational study on 100 cases

Table No 27: Study Population

Sl No	Gender	Number
1.	Male	31
2.	Female	69
	Total	100

Table No 28: Occupation and cases

Sl No	Occupation	Number
1.	Housewife	46
2.	Outside work	54
	Total	100

Table No 29: Laterality and gender

		Gender		Total
		Male	Female	
Laterality	OS	11	22	33
	OD	18	35	53
	OU	2	12	14
Total		31	69	100

Table No 30: Presenting complaint and socio-economic status

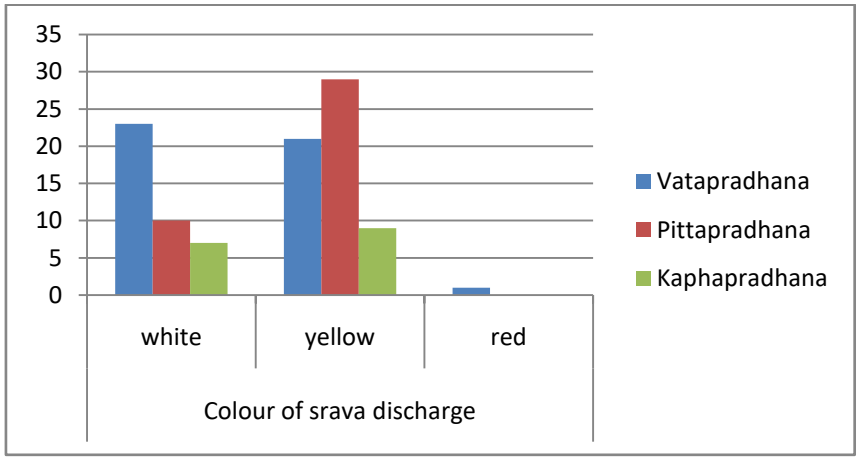
	Socioeconomic status			Total
		low	mid	
Presenting Complaint	EP	15	4	19
	EP+SW	13	6	19
	EP+DIS	8	9	17
	EP+SW+DIS	28	17	45
Total		64	36	100

Table no 31: Results of Clinical observational study on 100 cases

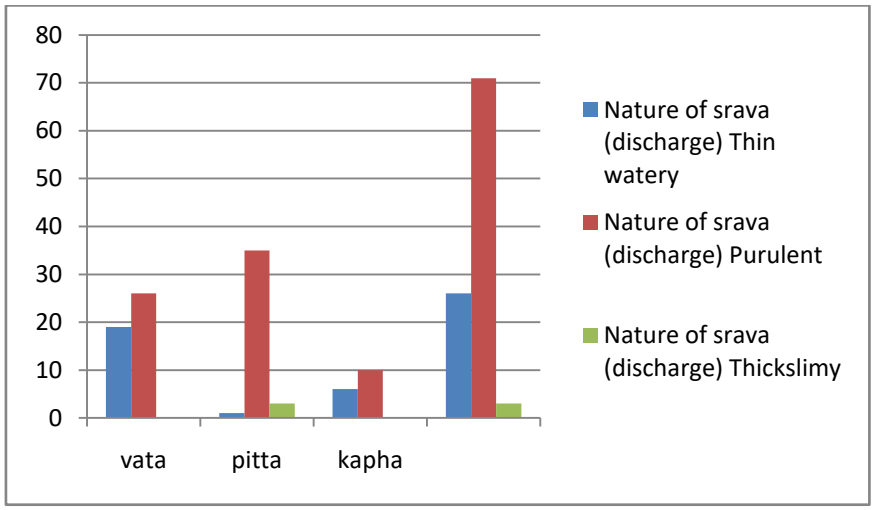
Parameters		**Prakruti pareeksha (Pradhana)**			
		Vata	Pitta	Kapha	Total
Colour of srava	White	23	10	7	40
	Yellow	21	29	9	59
	Red	1	0	0	1
	Total	45	39	16	100
Nature of srava	Thin watery	19	1	6	26
	Purulent	26	35	10	71
	Thickslimy	0	3	0	3
	Total	45	39	16	100
Quantity of srava	Mild	4	7	0	11
	Moderate	41	20	15	76
	Profuse	0	12	1	13
	Total	45	39	16	100
Gradings of discharge	Grade 1	13	1	4	18
	Grade 2	8	2	9	19
	Grade 3	0	1	0	1
	Grade 4	24	35	3	62
	Total	45	39	16	100
Asso.Nasal Pathology	Nil	34	21	10	65
	Dns	10	18	6	34
	Swollen turbinate	1	0	0	1
	Total	45	39	16	100
Visual acquity	6/6	35	22	13	70
	6/9	4	4	3	11
	6/12	5	12	0	17
	6/15	0	1	0	1
	6/18	1	0	0	1
	Total	45	39	16	100
External ocular	Abnormal	45	39	16	100
	Total	45	39	16	100
Eyelids-Skin over	Normal	45	39	16	100
	Total	45	39	16	100
Odema	Localised	9	4	0	13
	Diffuse	4	2	0	06
	Absent	32	33	16	81
	Total	45	39	16	100
Vesicles	Absent	43	37	16	96
	Present	2	2	0	4
	Total	45	39	16	100
Position of Eyelid	Normal	45	39	16	100
	Total	45	39	16	100
Movement of eyelid	Follows eyeball	45	39	16	100
	Total	45	39	16	100
Lidmargin	No abnormality	42	37	16	95
	Abnormal	3	2	0	5
	Total	45	39	16	100
Position of punctum	Normal	44	38	16	98

	Abnormal	1	1	0	2
	Total	45	39	16	100
Approx size of	Normal	22	5	13	40
	Abnormal	23	34	3	60
	Total	45	39	16	100
Lacrimal sac area	Normal	22	8	7	37
	Abnormal	23	31	9	63
	Total	45	39	16	100
Lacrimal puncta	Normal	24	17	7	48
	Abnormal	21	22	9	52
	Total	45	39	16	100
Functional variation	Grade 1	22	12	13	47
	Grade 2	23	27	3	53
	Total	45	39	16	100
Schirmer test1	Normal	27	24	8	59
	Hypersecretion	16	13	4	33
	Dry eye	2	2	4	8
	Total	45	39	16	100
Tear breakup time	0	10	3	5	18
	Normal(more	34	36	10	80
	Deficiency of	1	0	1	2
	Total	45	39	16	100
Block in sac	Com	28	32	4	64
	Par	17	7	12	36
	Total	45	39	16	100
Regurgitant on sac	Clear	14	1	6	21
	Mucopurulant	31	36	3	70
	Purulant	0	2	7	9
	Total	45	39	16	100
ROPLAS	Clear /mucoid/MP	45	37	16	98
	No reg but sac	0	2	0	2
	Total	45	39	16	100
Diagnostic probing	Res@3mm	26	15	8	49
	Res@3to8mm	19	24	8	51
	Total	45	39	16	100

Graph No 22 - Colour of srava discharge

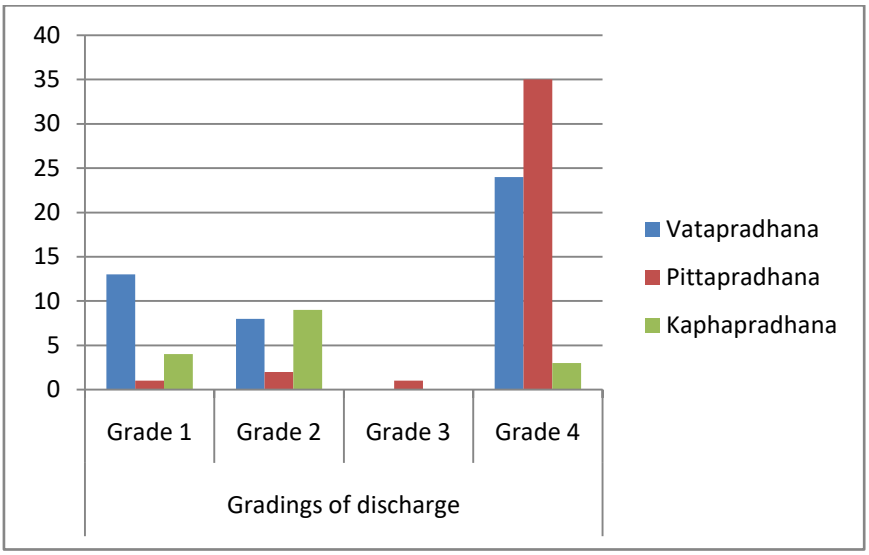


Graph No 23 - Nature of srava discharge

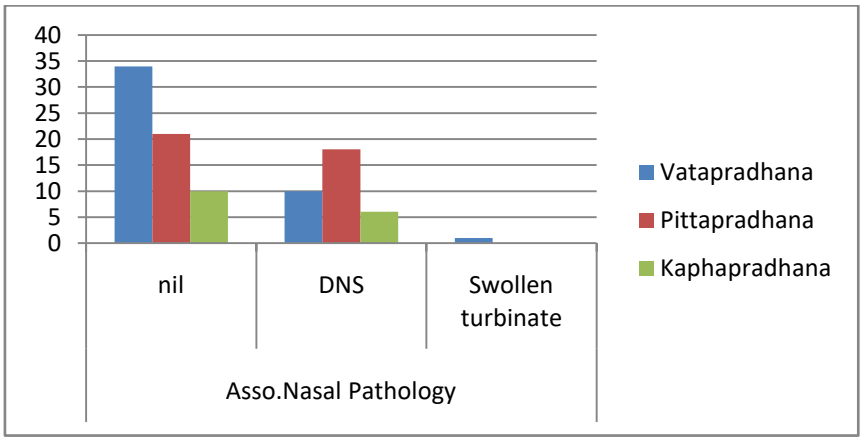


Graph No 24 - Quantity of srava

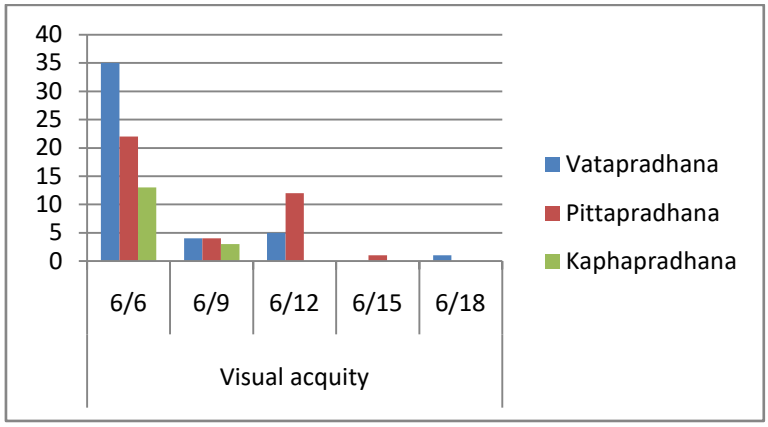
Graph No 25- Grading of discharge



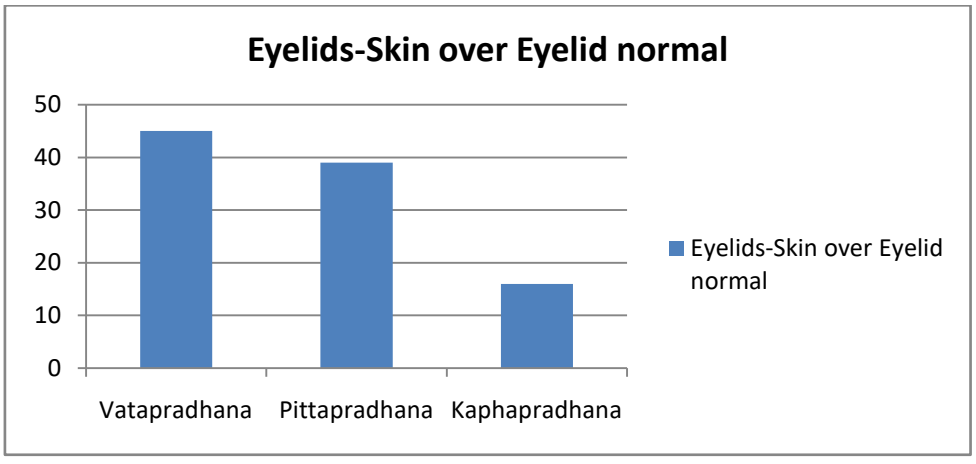
Graph No 26- Asso.Nasal Pathology



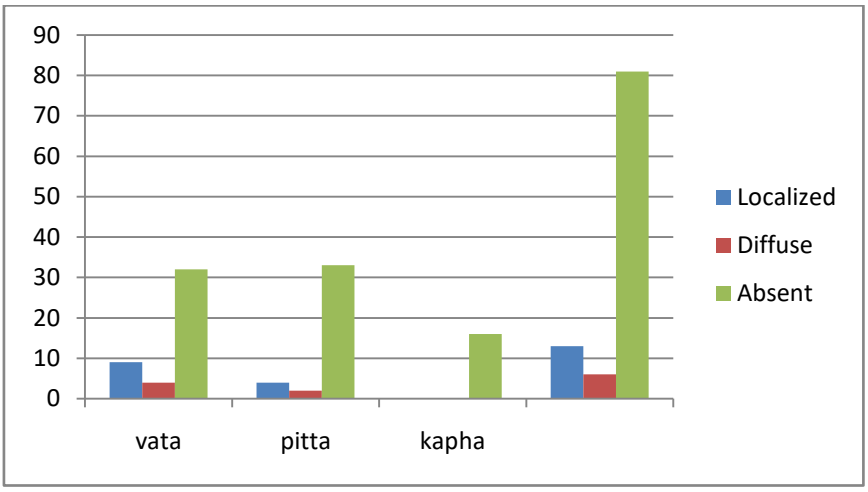
Graph No 27 - Visual acquity



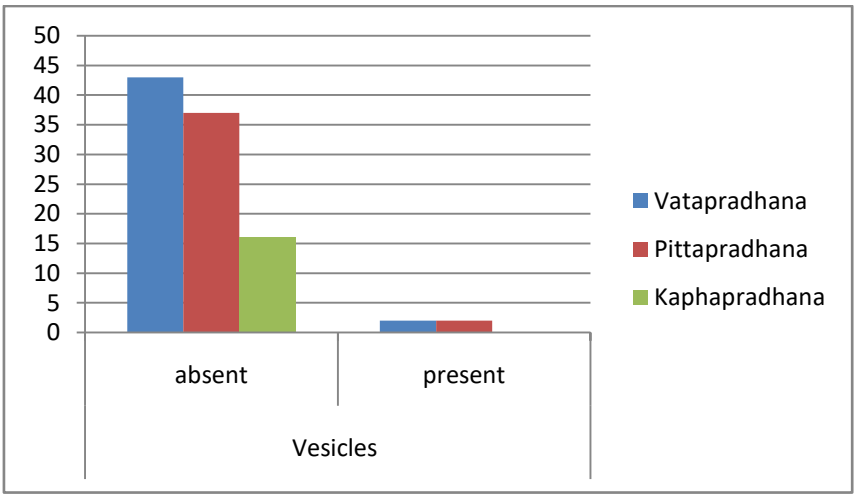
Graph No 28 - Eyelids-Skin over Eyelid



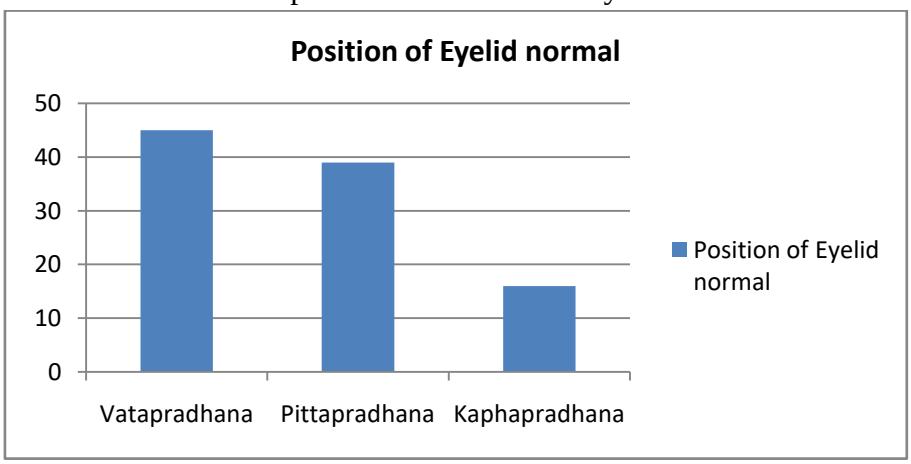
Graph No 29 - Odema and Prakruti Pariksha



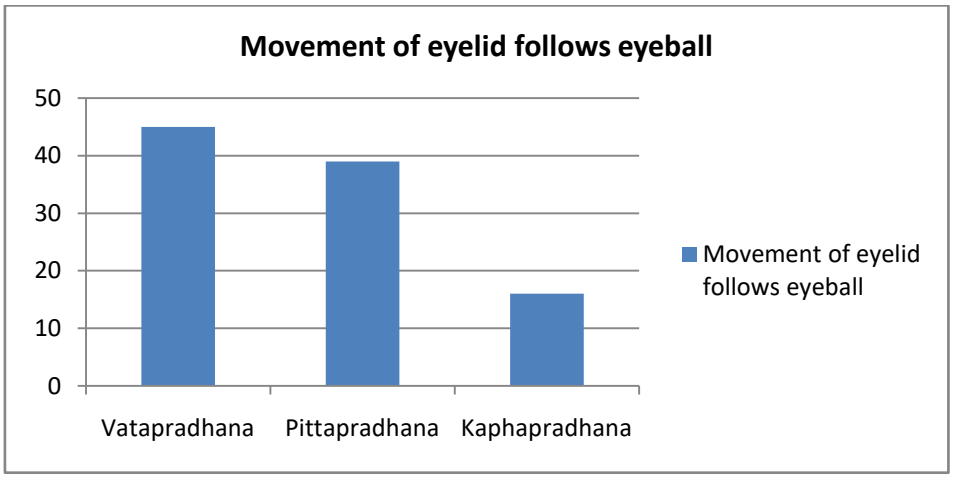
Graph No 30 - Vesicles



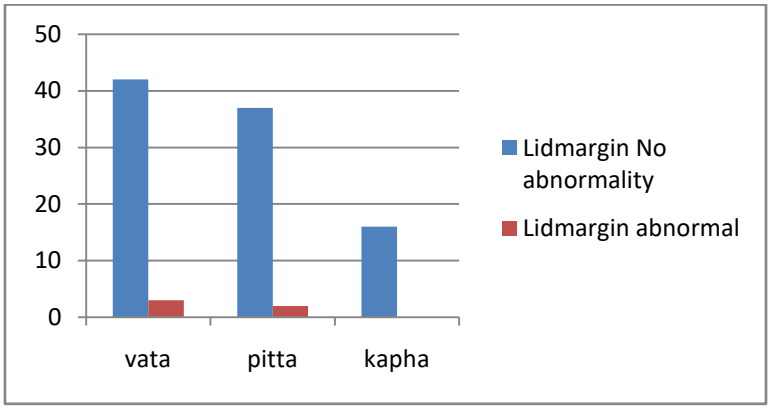
Graph No 31 - Position of Eyelid



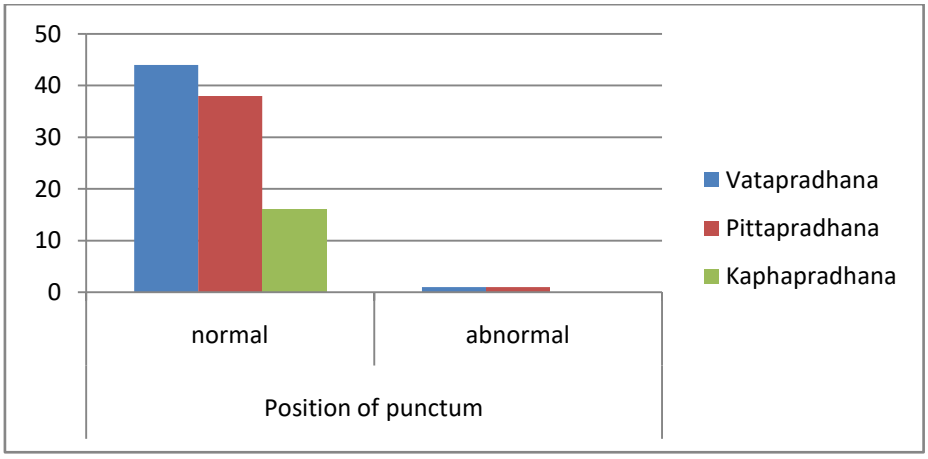
Graph No 32 - Movement of eyelid



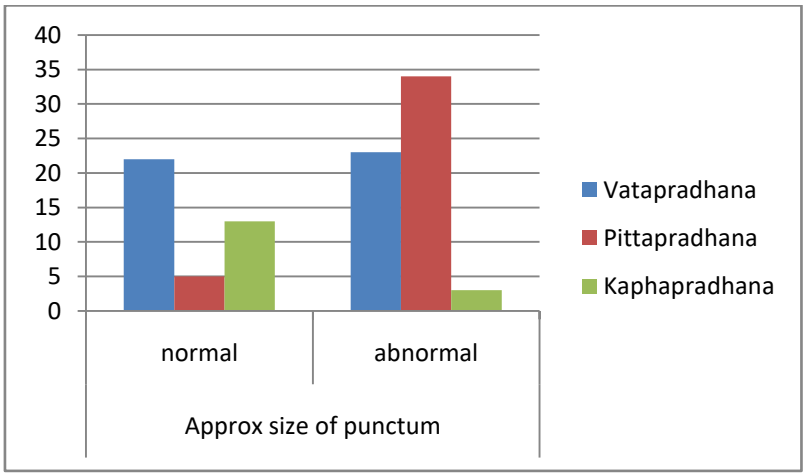
Graph No 33 - Lidmargin



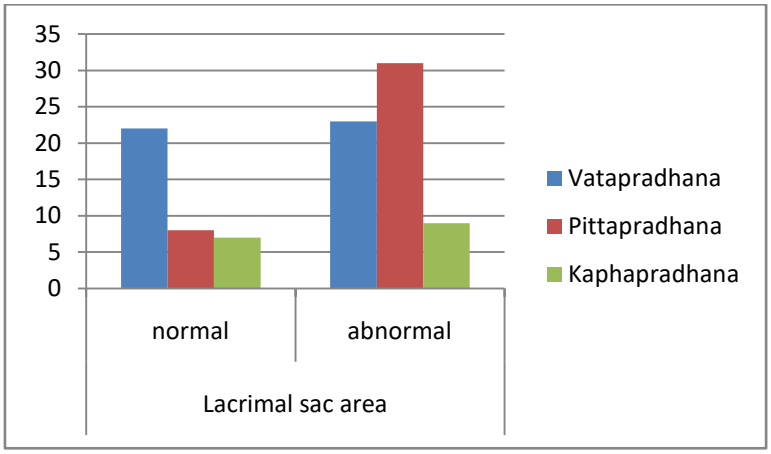
Graph No 34 - Position of punctum



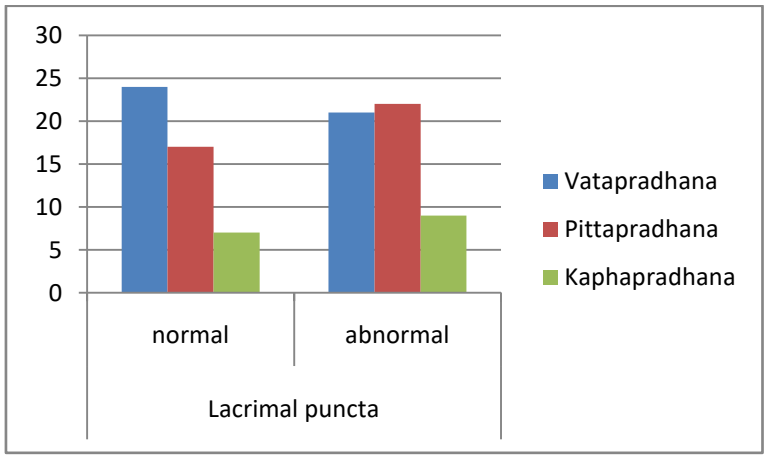
Graph No 35 - Approx size of punctum



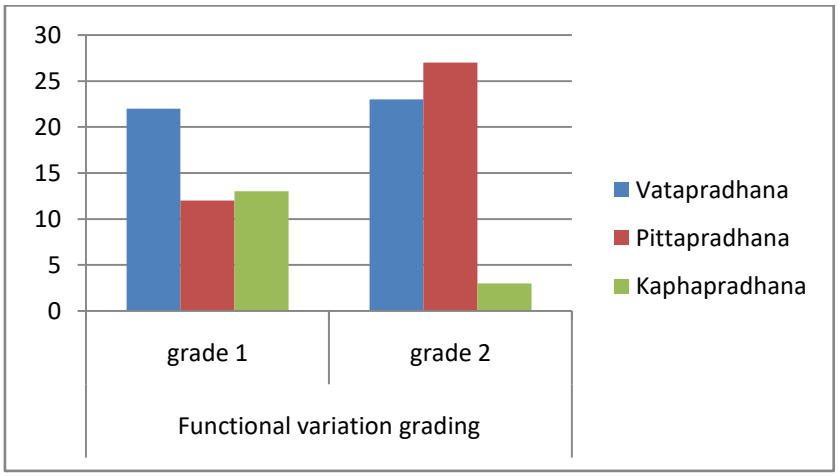
Graph No 36 - Lacrimal sac area



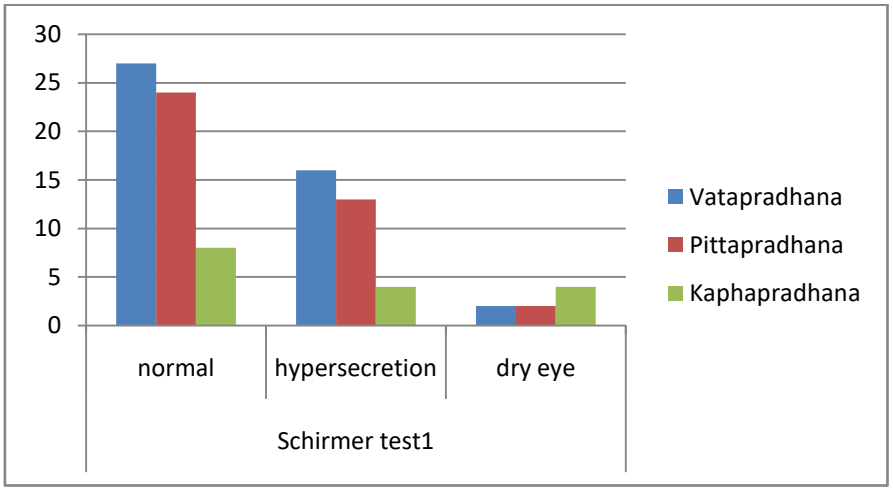
Graph No 37 - Lacrimal puncta



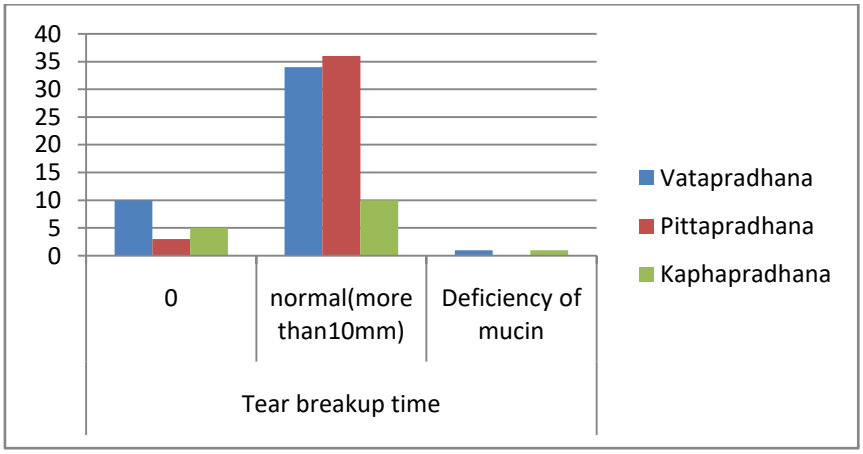
Graph No 38 - Functional variation grading



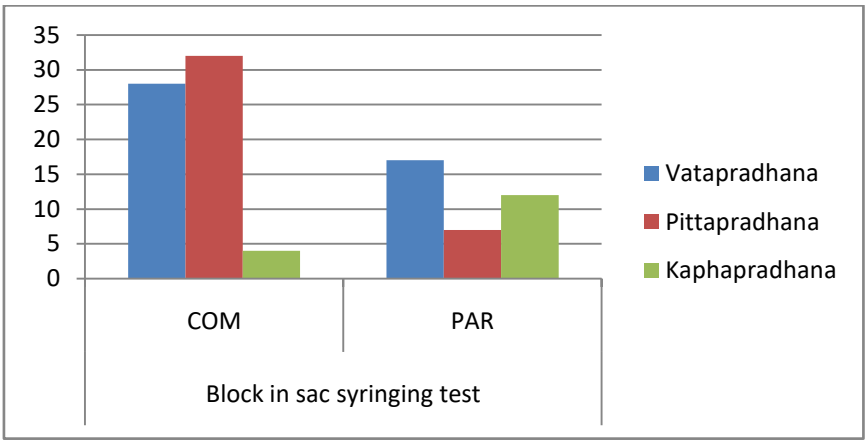
Graph No 39 - Schirmer test1



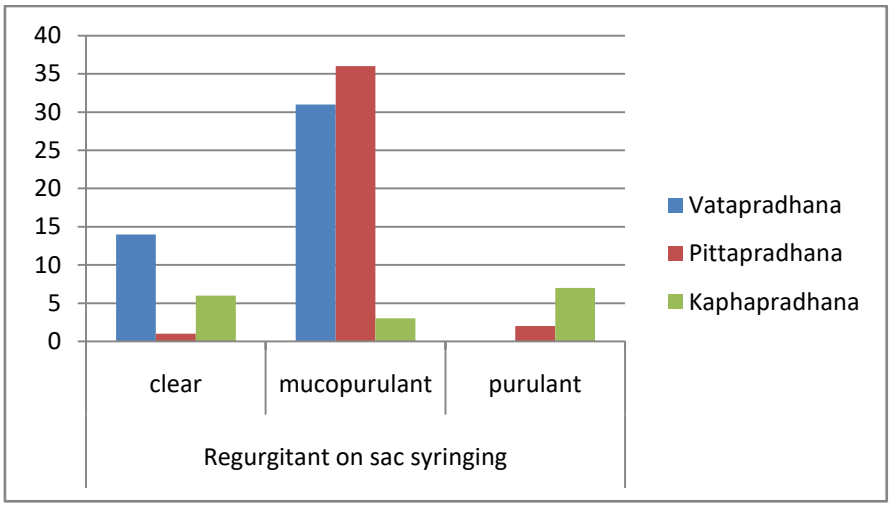
Graph No 40 - Tear breakup time



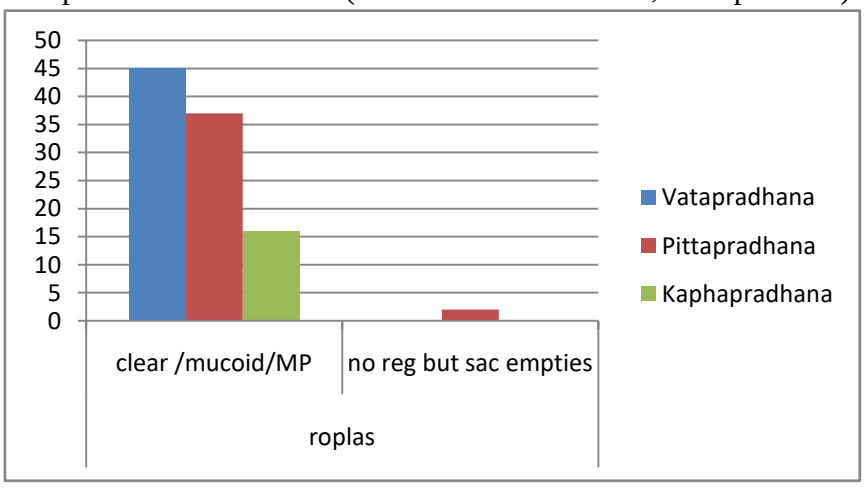
Graph No 41 - Block in sac syringing test



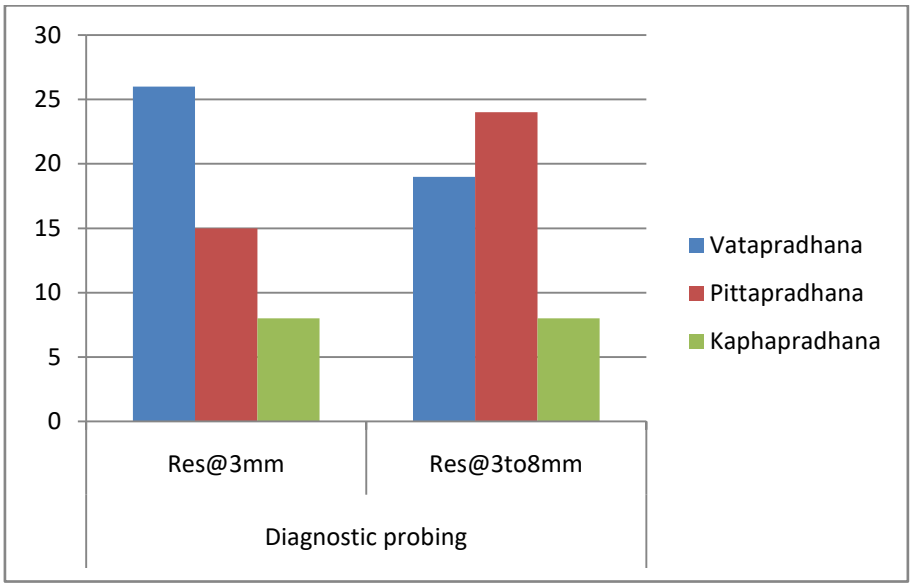
Graph No 42 - Regurgitant on sac syringing



Graph No 43 – ROPLAS (Positive- Clear/mucoid,Mucopurulant)



Graph No 44 - Diagnostic probing



INTERPRETATION

A. LITERARY REVIEW

While describing the qualities of drugs and food materials in sutrasthana and vimansthana of Charaka samhita clearly mentioned that the description is just introductory. Intelligent scholar can examine and use the new drug by reading these properties which are explained respectively. Anukta vyadhi chikitsa concept was utilized by Charakacharya in chiliast sthana also, much more references can be found in classics which suggest that there is need to explain the unestablished concepts as expected by our acharyas from us.

Srotas

The review was carried on detailed way to find hidden concepts of srotas starting from the Veada,Samhita Granthas and relevant texts.

Here it has been referred as marga (path), dhamanya and khani which have a close resemblance of the synonyms of srotas given by Acharya Charka in Vimansthana. In Atharaveda the world srotaya has been given which closely resembles with the etymological derivations of srotas as "*Su Sravane*". In Atharvaveda the word asrav denotes the Raktavara Srotas, the concept of Bahir mukha srotas has been mentioned in Atharvaveda as Navadwara. In Yajurveda the term Pranasya Pantha denotes the Pranavaha Srotas which flows the Prana to the body. The above instance of srotas clearly indicates a transport system of the body either in macro or in micro form. Here we find the term of Srotas being derived and defined in various contexts. This helps us to understand the core concept of Srotas.

Acharya Charka has tried to explain the definition of srotas in scientific way. If we closely analyze it can be considered that srotas are the micro and macro structural aspects which absorb the external substances inside and in turn are responsible for ejecting the waste products after the process of digestion.

Acharya Charka has presented the particular description of srotas keeping in view the natural, physical structures resembling as that of stream, river, tank spring channels etc he has presented all the explanation based on scientific back ground.

Charka considered the body as conglomeration of srotas, he considered srotas (*srotomayam hi purash*), he considered srotas as transported system and they are present in the form of constructive structures. Based on the above explanation

Acharya Charka has tried to explain the definition of srotas in more scientific way, if it is closely analysed it can be considered as micro and macro hollow structures present inside the body which absorb the external substances inside and in turn are also responsible for excreting the waste products produced after the process of digestion. Acharaya Sushruta was also equally scientific but as he was authority of surgery views of approach is different towards the subject.

Charaka tried to describe the Srotas right from the subject level where as Sushruta described their gross structural aspect. Acharya Sushruta presented the Srotas in gross or macro form, as he was Surgeon; he presented his findings observed during dissection. If a close observation is made regarding the description of Srotas, we find the difference between Charaka views with Sushruta. Charaka being a physician, most of the preference is bringing allocated to biological aspect of the body and Sushruta gave more importance to surgical aspect. The condition of Charaka in this regard helps the physician to understand the Rachana of Srotas to a greater extent and their role in the causation of the disease.

Anukta srotas

Study of Anukta srotas should be conducted under the headings as a) Srava of the srotas b) Name of srotas according to srava of respective srotas c) Mulasthanas of anukta srotas d) Vyapti or Anatomical limitation if possible e) Dushti laxanas of Anukta srotas f) Dushti hetus of Anukta srotas g) Possible line of treatment of anukta srotas.

Netra

- The Evolution of netra and ophthalmology was studied from the vedic period. samhitha and other books.
- The concept of netra utpatti, nirukti and its derivations, Paryaya, anatomical pats of netra, mandala, sandhis, patala etc.
- The process of Jnanotpatti with the indriya and manas is being highlighted. The functions of the Trisodha in the eye is being described which is necessary for this study.
- The netra vyadhi and additional points from Bhavamishra, Yogaratnakara, Dalhana, Hareetha samhitha, Sharangadhara is being explained.The nidana panchaka and treatment of the netra vyadhi which is essential in this study has

been described.

Ashru

Ashru is clear, non-viscous and watery fluid, as evident from its synonyms and its comparison with waterfall. This term appear in references of disease as well as physiological secretion. In this reference one more term Akshivita' or 'Netravita' is described as the Mala (excrement) of Majja Dhatu. It is a physiological secretion which is scanty, oily, and whitish and lubricates the eyeball. Its deficiency result in dryness, pain, lightness and numbness in its site means netra. As per modern science also Dry eye occurs, when there is inadequate tear volume or function, resulting in an unstable tear film and ocular surface disease.

Tear film is responsible

- To Protect and lubricate the eye providing good optical surface
- Reduce the risk of eye infection
- Keep the surface of the eyes smooth and clear Tear secretion can be in form of basal, reflex or psychic tears.

Ashru can be divided into three broad categories

- Vyapta Ashru- Ashru cleanses the covering of eye i.e. ocular surface. Sleshaka and tarpaka Kapha moistens the eye through the lacrimal secretions. It mentions normal lacrimation which is continuously secreted throughout the day in form of basal tear secretion. It is derived from the accessory lacrimal glands (of Krause and Wolfring) located in the conjunctival fornices.
- Ashru vega - Ashru (tears) secreted in flow in response to psychological stimuli as during excessive joy or sorrow denotes Ashru vega. It mentions reflex secretion in form of additional tear secretion. It often serves to clean the eyes in response to irritation of the eyes. It is provided by the main lacrimal gland in response to a background of stimuli to the cornea and retina. It may also psychic tears in response to strong internal emotions such as sorrow, love, elation, pleasure. Laughing or yawning may also lead to the production of tears.
- Ashru srava - Different varieties of Ashru-sravas have been described as a feature of many eye diseases as mentioned in symptoms of Vataja Abhishyanda, in form of dushika in Kaphaja Abhishyanda and as a result of application of Anjana in contra indicated conditions.

Origin of Ashru Any specific structure is not mentioned in Ayurvedic texts from where Ashru are released. Following points can take in consideration to clear this concept.

Role of dosha on Ashru

- Ashru is originated from kapha so posseses kapha like properties, and provides lubrication and immunity by its bala activity.
- Acharya Bhavamishra has described that Akshivita (mala of majja) is brought in the eye by Vyana Vayu through sira and deposited there.
- Tear film is spread by blinking of eye lids. Vyan vayu is responsible for opening and closing the eyes, so responsible for spreading the Ashru.

Role of Dhatus

Ashru being watery in nature, it may be postulated that Ashru is derived from Rasa dhatu. Its functions in eye are similar to that of Ras dhatu in the body. It restores the wear and tear and provides nutrition to the outer tunics. This hypothesis is further strengthened by the presence of dryness and roughness of eyes as a symptom of Vataja Jwara and Vataja Pandu where the principal dushya is Rasa dhatu. Acharya Sharangdhara has even mentioned the aqueous discharges from eyes as the Mala of Rasa dhatu along with other discharges from mucosal surfaces. Meda dhatu is probably also related with the Snehana of the eyeball, as evident from the functions of Meda dhatu and the features of Meda Sara Purusha. In Meda-kshaya, the lusture of eyeball is lost. Two Tarun-asthis in the lids has also described. Asthi being the seat of Majja dhatu , these Tarun-asthis are the probable structures from where the Majja Mala (Akshi-sneha) is excreted. As it's clear from above that rasa, meda and majja dhatus are responsible for formation of Ashru.

The tear film coating the eye also has three distinct layers, from the most outer surface which may be correlated as

1. Lipid layer- lipoidal Secretions of meda dhatu
2. Aqueous layer- water secretions of rasa dhatu
3. Mucous layer- secretions as majja dhatu mala in form of akshivita.

Role of Panchmahabhoota

Tear film establish a refractive surface of high quality for the cornea and ensure the well being of the cornea and conjunctival epithelium. It's clear that ashru remains in

close contact with the Krishna part (Cornea) and the Sita part (Sclera with conjuctival covering) of netra. It is considered under outermost patala Tejo-Jalashrita patala. According to Acharya Sushruta, Sita part is derived from Jala Mahabhuta. Ashru is also derived from rasa dhatu whose Panchbhautic constitution is Jala predominant. It postulated that jala mahabhoota is important for Ashru.

Anatomical structure related to ashru

- There are two Ashru vahini Dhamanis (one in each eye). These channels are concerned with carriage of Ashru, although it is not clear whether these channels are related with secretion or excretion of Ashru.
- Another structure associated with transmigration of Ashru is the Ashrumargas referred in the description of 'Srava rogas'. Ashrumargas are derived from akasha mahabhoot which is having space similarly as Lacrimal passages. Ashrumargas are situated in kaneenaka sandhi. As regards their working, it is clear from their anatomic location and description of function that these are concerned with the drainage of Ashru.

According to modern science also those who suffer from the inherited disease familial dysautonomia not only cannot cry tears, but also have a very low ability to deal with stressful events. Suppressing tears increase stress levels and contribute to diseases aggravated by stress, such as high blood pressure, heart problems and peptic ulcers. In the management of these symptoms Swapna (sleep), Madhya (medicated alcohol), Priya katha (pleasant stories, hearty discussions and interactions with near and dear ones) is indicated. After knowing the importance of Ashru vega, one should not suppressed it. As one author notes, 'The importance of tears can best be recognized by seeing what happens when someone does not have them.'

Ashru and Dushika terms are mentioned together in some references, like in symptoms of Vataja Abhishyanda (As.Hr.Ut.,15.2-3), Kaphaja Abhishyanda (As.S.Ut.,18.9) and as a result of application of Anjana in contra indicated conditions (As.S.Su.,32). Different varieties of Ashru-sravas have been described as a feature of many eye diseases. It clarifies the separate entity of these two types of secretions, but it also indicates the morbid origin of the Ashru. In the references of Netra-nadi-roga, Acharya Dalhana elucidates term Ashru-srava delineates the vitiating dosha as well.

B. CADAVER STUDY

The anatomical study of the lacrimal apparatus forms the base and gives all the relevant information required for the clinical diagnosis and the treatment aspect. The study of the clinical anatomy helps in understanding the important landmarks needed to be known for the understanding the pathology, diagnostic probing of the structures involved and the surgical interventions. Previous studies have also established the fact that knowledge of the anatomy of Lacrimal apparatus plays an important role and is essential for the surgical success or outcome of the procedure.

Considering these aspects this study was done to review the anatomical landmarks in the nasolacrimal apparatus so that it helps in better understanding of the pathology and the diagnostic as well as treatment procedures. The anatomical study was done in five cadavers applying the statistical test of Correlation and descriptive statistics.

The dissection was carried on following points,

1. **Maxillary line**

The maxillary line is the mucosal eminence and it is curvilinear extending from the axilla to the dorsum of inferior turbinate. In this study about 70% was clearly identified among total 5 cadavers. (Right side -4 left side-3) and not clear in 30% (Right side -1 left side-2). Previous study has also reported that in 88% of cases the maxillary line can be identified in cadavers[85].

2. **Maxillary line length- from axilla to inferior turbinate**

In this study, average mean length of the maxillary line was 12.46 mm with a range of 11.99 to 13.01 mm. It was also noted that there was presence of a ridge on the superior surface of inferior turbinate next to the medial border, with this ridge an imaginary line can be drawn ,that could help in the intervention during the surgery for the surgeons, especially during the dacrocystorhinostomy procedures. Where lacrimal sac and nasolacrimal ducts joins, the line is known as maxillary line and midpoint of this is level of superior aspect of maxillary sinus.

3. **Distance between Anterior nasal spine to M point (mid point of maxillary line)**

The distance between anterior nasal spine to M point was found to be 29.77 in right side and 29.87 in left side. The Pearson Correlation was - 0.832 and the P value was 0.080. Correlation was not statistically significant at the 0.01 level (2-tailed).The previous study however reported M point to be of approximately 29.93 mm as well as 39mm .In this study the measurement is found to be less than these previous studies as the distance is taken from the anterior nasal spine and not nasal sill.

In live subjects, the M point was approximately 3.9 cm from the nasal sill in women and 4.8 cm in men. Understanding the conserved relationships of the maxillary line and M point with adjacent nasal and orbital structures will ensure the complete removal of the uncinate process during uncinectomy and promote safe and ample exposure of the lacrimal sac during endoscopic dacryocystorhinostomy.

4. **Measurement between Relations of lacrimo maxillary suture line to maxillary line**

Lacrimo maxillary suture was seen anterior to maxillary line in 4(40%) and posterior to maxillary line in 4 (40%) cases and above maxillary line in 2(20%) specimens .In a previous study of Orhan et.al, it was noted that about 18 to 20 cadavers had the maxillary line overlapping the lacrimal sac and hence considering this it was found that an incision drawn anterior to maxillary line could be sufficient to expose the lacrimal sac[86].

5. **Thickness of lacrimal bone**

The average thickness of the lacrimal bone in this study was found to be 0.24 mm (rt side) and 0.25 mm (lft side).The Pearson Correlation was 0.721 and P value was 0.170 which is more than 0.001 and hence Correlation is not significant at the 0.01 level (2-tailed).Other studies of hartikainen el.al mentions the mean thickness to be 0.106mm. One more study of Yung et.al also depicts that the lacrimal bone covers the posteromedial aspect of lower lacrimal sac. In this study it was found that lacrimal bone is slightly thick than as mentioned in previous studies.

As lacrimal is thin bone and can easily penetrate with surgical instruments so care should be taken during surgery.

6. After removal of lacrimal bone: lacrimal sac seen

(less than half more than half/ not seen)

The lower part of lacrimal sac was seen less than half in 6(60%) cases and more than half in 4 (40%) after removal of the lacrimal bone. It is seen in the study conducted by Yung et.al that, lacrimal bone is present at the level of posteriomedial aspect of the upper lacrimal duct and lower lacrimal sac, which corresponds to lacrimal passage[87].

7. Superior end of sac (at / below/ above axilla)

In the total cases, in 6(60%) cases the superior end of sac was above axilla and in 4(40%) it was below the axilla

8. Anteroposterior diameter of lacrimal sac

The average anteroposterior diameter of lacrimal sac was 7.43mm Pearson Correlation – 0.087 and P value was 0.890 and hence there is no significant difference found and also Correlation is not significant at the 0.01 level (2-tailed)

9. Length of lacrimal sac (in mm)

In this study the average length of lacrimal sac was 11.91mm. Pearson Correlation was – 0.054 and the P value was 0.931 and hence the Correlation is not significant at the 0.01 level (2-tailed). Length of lacrimal sac in the study of Orhan et.al was with the reading of 12.76mm which is close to the present study.

10. The relation between the lacrimal sac and the maxillary line

Lacrimal sac was more than half anterior to maxillary line in 60 % of cases and less than half anterior in 40% of cases

11. Relation of anterior point of middle turbinate to nasolacrimal duct

Middle turbinate genu was found at NLD in 20% of cases and posterior in 60% of cases and anterior in 20% of cases. P value was 0.000 and hence Correlation was significant at the 0.01 level (2-tailed)and Pearson Correlation was – 1.000

12. Length of the nasolacrimal duct (from the transition area between the sac and duct up to the intranasal orifice)

The average length of nasolacrimal duct was 10.1mm and P value was 0.683 and Pearson Correlation – 0.252 and so Correlation was not significant at the 0.01 level (2-tailed). In the similar previous study of Lin et.al reported that the length of nasolacrimal duct average was 14.14mm.

Groell et al did CT examination in 147 patients and demonstrated that the mean length of the nasolacrimal duct was 11.2 +/- 2.6 mm; the narrowest diameter was 3.7 +/- 0.7 mm[88&89].

C. Clinical Observational study

The discussion on Clinical observational study on 100 subjects is presented under following headings to get clear knowledge and trying to correlate with Ayrvedic basic concept like Prakruti.

The subjective and objective parameters are put under 5 main domains.

1. Domain 1 – Srava
2. Domain 2 -Asso.Nasal Pathology, Visual acquity, External ocular Examination, Eyelids-Skin over Eyelid, Odema, Vesicles
3. Domain 3 - Punctum, lacrimal sac area and functional grading
4. Domain 4 - Schirmer test and Tear breakup time
5. Domian 5 - Block in sac syringing test, Regurgitant on sac syringing, ROPLAS, Diagnostic probing

Table no 32 - Domain 1- Srava

Colour of srava/ discharge	Prakruti pareeksha				
	Features	Vatapradhana	Pittapradhana	Kaphapradhana	Total
	White	23	10	7	40
	Yellow	21	29	9	59
	Red	1	0	0	1
	Total	45	39	16	100
Nature of srava/ discharge	Thin	19	1	6	26
	Purulent	26	35	10	71
	Thickslimy	0	3	0	3
	Total	45	39	16	100
Quantity of srava	Mild	4	7	0	11
	moderate	41	20	15	76
	Profuse	0	12	1	13
	Total	45	39	16	100
Grading of discharge	Grade 1	13	1	4	18
	Grade 2	8	2	9	19
	Grade 3	0	1	0	1
	Grade 4	24	35	3	62
	Total	45	39	16	100

- Colour of srava/ discharge - The colour of srava or discharge was observed as white, yellow and red.
- Nature of srava/ discharge- Thin watery/Purulent /thick/slimy/Blood mixed
- Quantity of srava- Mild /Moderate/Profuse
- Grading of discharge

In the domain of srava, it can be seen that the discharges from the Ashruvaha srotus is seen predominantly with thin and clear followed by purulent and mucopurulamt discharge. The causative factor for the pathological srava lies in the Ashruvaha srotas. One type that can occur is decreased or ceased flow of srava due to obstruction in the srotas or any other cause. Second one that can occur is the condition in which it gets vitiated due to Sanga of dushita dosha and it is considered as the Sanga and also can be called as Khavigunya of the respective srotas. In this study it was found that Vatapradhana and Pittapradhana predominantly showing the Srava followed by the Kaphapradana. The puyasrava with frequent, purulent discharge was seen which involves Tridosha can be considered here. The pittasrava has yellowish or jala (watery in consistency) was also according to the functional gradings also Grade 1, Grade 2 , Grade 3, Grade 4 was seen.

Table no 33: Domain 2- Associated Nasal Pathology, Visual acquity, External ocular Examination, Eyelids-Skin over Eyelid, Odema and Vesicles

	Prakruti pareeksha				
	Features	Vatapradhana	Pittapradhana	Kaphapradhana	Total
Asso.Nasal Pathology	Nil	34	21	10	65
	DNS	10	18	6	34
	Swollen turbinate	1	0	0	1
	Total	45	39	16	100
Visual acuity	6/6	35	22	13	70
	6/9	4	4	3	11
	6/12	5	12	0	17
	6/15	0	1	0	1
	6/18	1	0	0	1
	Total	45	39	16	100
External ocular Examination	abnormal	45	39	16	100
	Total	45	39	16	100

Eyelids-Skin over Eyelid	Normal	45	39	16	100
	Total	45	39	16	100
Odema	Localised	43	39	16	98
	Absent	2	0	0	2
	Total	45	39	16	100
Vesicles	Absent	43	37	16	96
	Present	2	2	0	4
	Total	45	39	16	100
Position of Eyelid	Normal	45	39	16	100
	Total	45	39	16	100
Movement of eyelid	follows eyeball	45	39	16	100
	Total	45	39	16	100
Lidmargin	no abnormality	43	37	16	96
	Abnormal	2	2	0	4
	Total	45	39	16	100

The other associated features and symptoms play a vital role in understanding the clinical implications of the anatomical entities and pathological process. Deviated nasal septum (DNS) was seen among 34 subjects. The visual acquity was found to be of insignificant in relation to the Ashruvaha srotas. The odema was seen localized in most of the condition along with the sraava. Vesicals were found in 2 cases. No abnormality was seen in any case of position and movement of eyelid.

Table No 34- Domain 3 : Punctum, lacrimal sac area and functional grading

Position of punctum		vatapradana	pittapradana	Kaphapradhana	
	Normal	44	38	16	98
	Abnormal	1	1	0	2
	Total	45	39	16	100
Approx size of punctum	Normal	22	5	13	40
	Abnormal	23	34	3	60
	Total	45	39	16	100
Lacrimal sac area	Normal	22	8	7	37
	Abnormal	23	31	9	63
	Total	45	39	16	100
Lacrimal puncta	Normal	24	17	7	48
	Abnormal	21	22	9	52
	Total	45	39	16	100

Functional variation grading	Grade 1	22	12	13	47
	Grade 2	23	27	3	53
	Total	45	39	16	100

In this study the position of the punctum was normal in all the 98 cases where as the size of the punctum was found to be abnormal or stenosed in 60 cases of which 23 vatapradhana ,34 cases of Pitta pradana and 3 cases of kaphapradhana .The lacrimal sac area presented with the abnormality with swelling and redness in 23 cases in vatapradhana, 31 cases in pitta pradhana and 9 case of kapha pradhana. The stenosis of the lacrimal puncta, swelling and redness are due to the doshaja sanga. It can be also termed as khagunya. The vyadhi caused by the doshaja sanga in Ashruvaha srotas are sometimes Paratantra, because it coud be also due to other diseases. On analyzing this concept we find that there could be other diseases in which the Ashruvah srotas is also been vitiated such as Pratishyaya, shroirogas and some urdhvajatrugatvikaras. Hence there will be an involvement of the structures of the drainage pathway of Ashru, i.e Nasolacrimal apparatus and the associated Nasal structures.

If we consider the anatomical entity that involved in this, the grades of the Punctal stenosis can be applied here for the interpretation.

Structural Variation

Type 1- Membranous block

Type 2- Peripunctal fibrosis

Type 3- Combined membranous block and peripunctal fibrosis

The Punctal stenosis was further evaluated by the Sac syringing and diagnostic probing

Table no 35- Domain 4: Schirmer test and Tear breakup time

		Vatapradana	Pittapradana	Kaphapradhana	
Schirmer test1	Normal	27	24	8	59
	Hypersecretion	16	13	4	33
	Dry Eye	2	2	4	8
	Total	45	39	16	100
Tear breakup time	0	10	3	5	18
	Normal(more	34	36	10	80
	Deficiency of	1	0	1	2
	Total	45	39	16	100

Both the condition hypo and hyper secretion (sanga and Atipravrutti) of tear are assessed by Schirmers test. This test is performed by inserting paper strips into the eyes and Lacrimation or Sravan of Ashruvaha srotas is assessed. Hence, eyes are the site for examination of Ashruvaha srotas. Hypersecretion was seen in 16 cases of vatapradana 13 cases of Pitta pradhana and 4case of kaphapradana. Here it may be due to the Atipravrutti of the dosha. While the Dry eye was seen in 8 cases.

When we go through modern aspects, we will get many diseases such as hyper secretion of lacrimal gland due to Hyper and hypo thyroidism, adverse effect of Birth control pills, etc. in which vitiated lacrimal system is observed. These conditions will never be relieved by treating lacrimal system, on contrary we have to target the main cause of disease. Hence, this condition can be termed as Doshajadisanga of Ashruvaha srotas and categorized under the heading of Paratantravyadhis

Table no 36 - Domain 5: Block in sac syringing test, Regurgitant on sac syringing,roplas ,Diagnostic probing

		Vatapradana	Pittapradana	Kaphapradhana	
Block in sac syringing test	Complete	28	32	4	64
	Partial	17	7	12	36
	Total	45	39	16	100
Regurgitant on sac syringing	Clear	14	1	6	21
	Mucopurulant	31	36	3	70
	Purulent	0	2	7	9
	Total	45	39	16	100
Roplas	Clear	45	37	16	98
	No reg but sac	0	2	0	2
	Total	45	39	16	100
Diagnostic probing	Res@3mm	26	15	8	49
	Res@3to8mm	19	24	8	51
	Total	45	39	16	100

On doing the sac syringing it was found that complete block was seen 28 cases of vata pradana, 32 cases of pitta pradana and 4 kaphapradhana.The regurgitant material were Purulent-9 and mucopurulant regurgitant -70 and from the punctum .The block was observed even in the clear regurgitant on sac syringing. On performing the ROPLAS test it was seen that clear ,mucoid and mucopurulant regurgitate was seen which as indicated the nasolacrimal duct obstruction

Diagnostic probing was done to check the level of the obstruction in the nasolacrimal passage, which showed that

- Resistance at 3mm from the the punctum indicating proximal canalicular obstruction.In this category 26 case of vatapradana,15cases of pittapradana and 8 case of kaphapradana was seen.
- Resistance at 3 to 8mm from punctum was observed in 19 cases of vatapradana, 24 case of pittapradana and 8 case of kaphapradana condition.

The regurgitation aspect can be interpreted in Ayurveda by the concept of Vimargagamana which is explained further in this discussion in Interpretation of Anatomical entities by clinical and diagnostic perspective

AYURVEDIC ASPECT OF ASHRUVAHA SROTAS AND ITS INTERPRETATION

a) Application of Trividha Pramana for Interpretation of Ashruvaha Srotas entities.

Elaborative application of the three examining tools mentioned by our acharyas i.e Pratyaksha pramana,Anumana and Aptopadesha can be applied in Anukta srotas as follows,

1. Pratyakshyapramana:

The Pratyakshapramana can be applied in the Cadaveric study and Clinical Observational study

- **Cadaveric Study**: By the dissection of the Nasolacrimal apparatus, the structures are measured by the Digital Venier Caliper. The utpattisthana and the Prabhavasthana of the ashruvaha srotas can be interpreted as lacrimal gland and lacrimal sac. These two structures also considered as Mulasthana. The vyapti of it can be considered as the drainage part of the ashru i.e the tear film, Canalicular parts, nasolacrimal duct.
- **Clinical observational study**: By the clinical observational study the anatomical structures and landmarks can be noted which are of important for diagnosis and treatment aspect. By the Pratyaksha pramana we can note the signs and symptoms of the ashruvahastroas such as swelling, colour of sraava, nature of sraava like clear, mucopurulant etc. In nasal examination, Deviated

nasal septum can be noted by Pratyakshamana. By the Diagnostic tools and test like schimers test the dry eye can be diagnosed.

2. Anumanapramana

- **Cadaveric study:** The tear film and the drainage of the tears can be understood by the anumana pramana.
- **Clinical study:** The nasolacrimal structural entities can be interpreted by the diagnostic procedures such as ROPLAS test, sac syringing ,the level of block in ashruvaha srotas of Complete block or partial block can be understood by Anumana pramana.

3. **Aptopadeshapramana**

In the classics the ashruvaha srotas is not mentioned directly under srotus but we find some terms related to ashru and its importance. By following the Aptavachana and applying Yukti pramana the reconstruction of ashruvasa srouts can be done.

B. Interpretation of Ashruvaha Srotas entities and terms based on Clinical Perspective.

The lacrimal apparatus can be stated in following headings,

- Secretory part, - Secretes tear
- Distributive – Spreads all over eye and maintain the moisture
- Excretory part – excess fluid excrete through nose, removes toxic material also.

By observing pathology related to srotas the terms can be stated as follows,

1.Mula stanana / Prabhava sthana/ utpatti stana

Following mentioned points are required to be considered while establishing the Mulasthana of srotas It may be a) Prabhava or Utpatti sthana b) channels carrying srava c) important place of srotodushti d) site for examination of the respective srotas e) place which when treated, entire srotodushti gets cured

Lacrimal gland and lacrimal sac are considered as mula sthana because most of the pathological cases related to this srotus were found in this area.

2.Vyapti of stotus /Ashrumarga

The ashru is secreted from Accessory lacrimal gland also (of Krause and wolfring) which are located in the conjuctival fornices.

The tubular channel which carries the srava of Ashrugranthi are, two pair of lacrimal canaliculi, tear film where some amount of tear is holding and naso lacrimal duct.

3.The main site in srotodushti

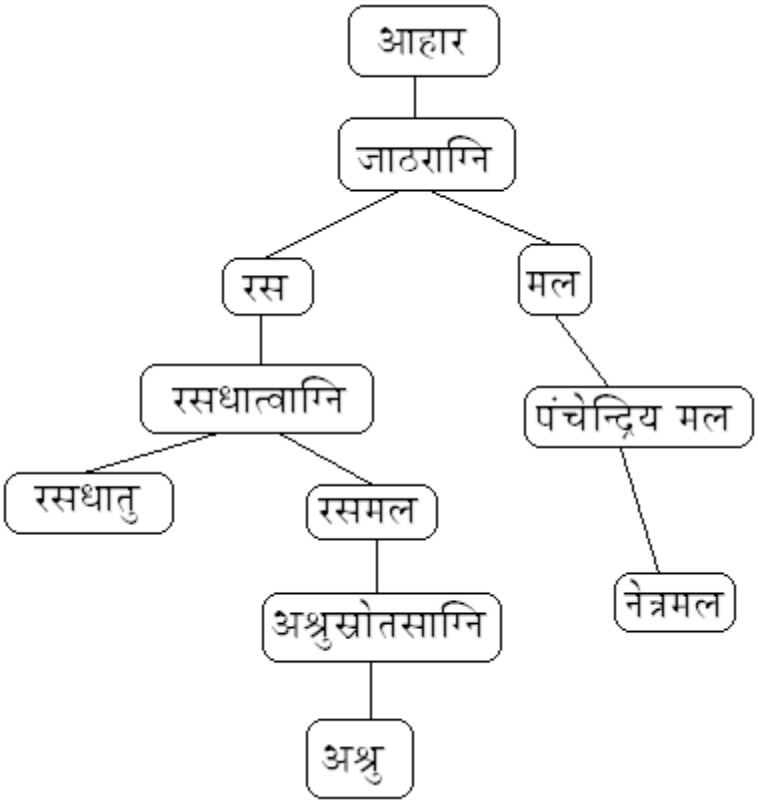
While going through srotodushti of Ashruvah srotas, we find that vitiation was more seen in lacrimal sac and nasolacrimal duct.

Ashru

Apart from this when there is utklesh of manasika bhavas then also ashru is formed and secreted. During such situation nirmiti (formation) of Ashru will be different from the above mentioned procedure.

It plays an important role in proper function of eyes, It is originated from kapha dosha, rasa, meda amd majja dhatu. It is predominant of jala mahabhuta.

The formation of Ashru can be represented like this,



Transport of Ashru

Vayu is stimulating factor for all the Indriyas. In eyes, the formation and transportation of Ashru is controlled by vata only. The formed Ashru is transported

and excreted with the help of vyana vayu. If any vitiation in vyana vata leads to vyadhi of Ashruvaha srotus.

Ashruvaha sroto karya

Netra mala Vahana, Samrakshana (Protection), Poshana (nourish) and maintains of Netra adrata (moisture) of Eye are the vital functions of Ashruvaha srotas.

Ashruvaha Dhamani:

Acharya Sushrutha while describing the sraava Roga has mentioned the pathological features of the sraava, which indicates that they had clear idea of the drainage part of the lacrimal apparatus. Sushrutha also mentions two ashruvaha dhamani (each in both eye) as place for production and nourishment of ashru.

Ashrumarga - Sushrutha and Dalhana both have described ashru marga and Netranadi especially Puyalasa, According to Sushrutha, the structures involved in ashrumarga are derived from aakasha mahabhuta which are having the space and thus it can be correlated and interpreted as lacrimal passages. It is mentioned that ashrumarga are located in Kaneenika sandhi.

Ashruvahini : vagabhata has mentioned the term Ashruvahini while describing about the Arma chedana karma.

Important anatomical entities in Radiology /CT Point of view

Normally the Lacrimal gland is not visible in the radiogram because of the osseous structures shows stronger shadow, but in case of lumpy changes the lacrimal gland, it differs. The division of the nasolacrimal duct into two parts as Upper orbital lobe and lower part is the bony canal of the duct. This division plays important role in diagnostic methods. The orbital part can be assessed by the ultrasound imaging while the lower part by X-ray or endoscopic techniques.

- The 90% of the tear fluid is drained by the lower lacrimal canaliculi through lower lacrimal punctum and hence this place requires special attention in the diagnostic process.
- Orbital lobe- site for lacrimal gland epithelial neoplasm
- Orbital and plapebral lobe- site for infilteration and inflammation

Concept of Ashruvaha srotodusti

The Ashruvaha srotodusti can be assessed by the Atipravrutti, Sanga, Siranam granthi and Vimarga gamana,

- **Atipravrutti** – Increase in the ashrusrava is considered as the atipravrutti, the disorders that can be considered here are,

  Jalasrava- vatadosha involved, watery (jalabha) Shopha (swelling), raga (redness) and discharge from vartma and kaneenika sandhi.

  Epiphora :

  - Pseudo Epiphora – Lacrimal gland hypersecreation
  - Anatomical (obstructive) Epiphora-Punctal abnormatilies

    Canalicular abnormatlities.

    Lacrimal Sac pathology

    Nasolacrimal duct obstruction

    Physiological (Non obstructive) Epiphora- Sac atonicity.

- **Sanga**

  It can occur in two ways such as

  1. Aapravrutti/ishad pravrutti- absence or very decreased ashru quantity leads to dry eye syndrome. Baspa is synonymous for Ashru and it is mentioned as adharaniya vega. Bashpavegavrodha janya vikara come under the Sanga .
  2. Doshaja Sanga-it is also called as khavaigunya and it could be due to the various factors like diseases or ama. It is mentioned as leading to the Poorvaroopa of netra roga and Siranaam granthi.

     Punctal stenosis can be considered under the sanga here and the

     GRADES OF PUNCTAL STENOSIS

     i. Structural variation

        Type 1- Membranous block

        Type 2- Peripunctal block

        Type 3 – Combined membranous block and peripunctal fibrosis.s

     ii. Functional variation

        Grade 1- narrow punctum but easily dilatable

        Grade 2- narrow punctum ,not easily dilatable

        Grade 3- Closed punctum with shallow punctual papilla

        Grade4 – Closed punctum with flat punctual papilla.

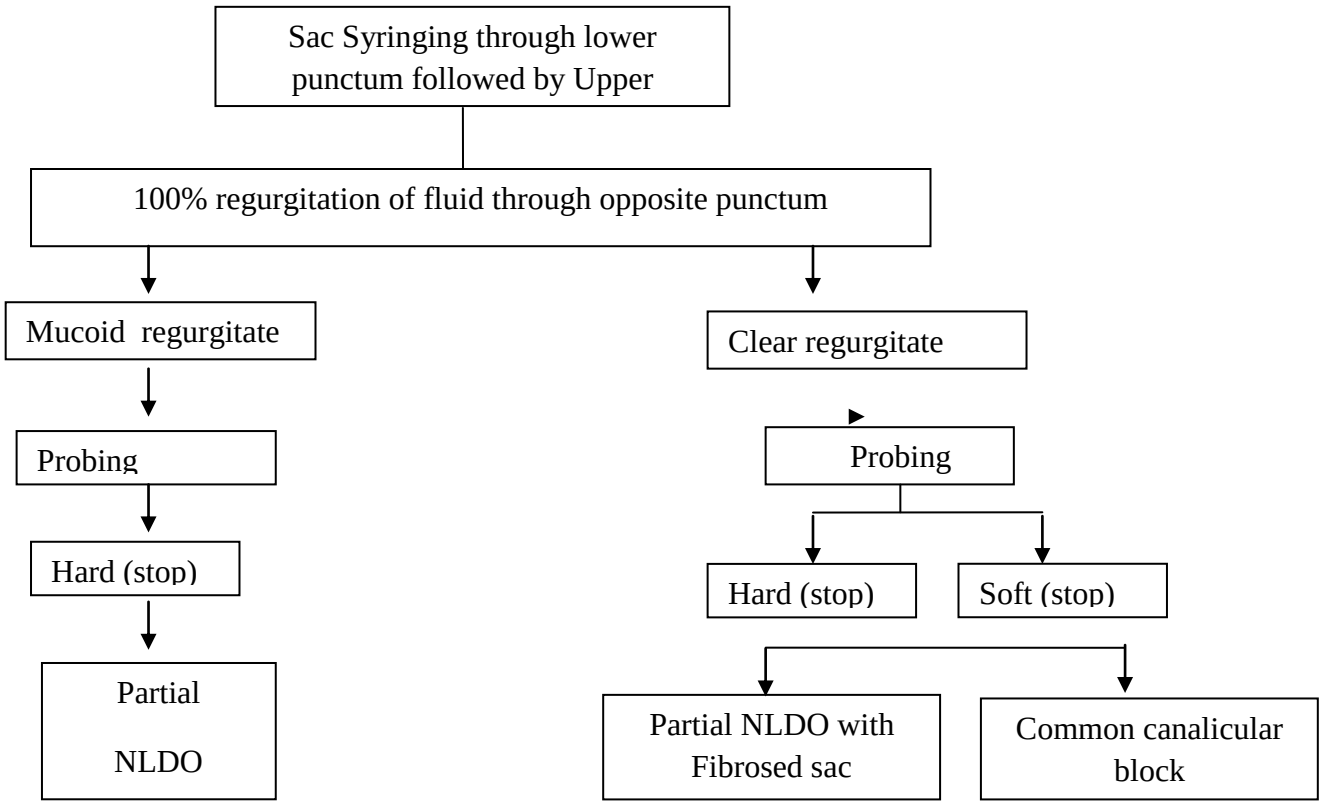
- **Siranam Granthi**- As mentioned above it occurs due to the khavaigunya or

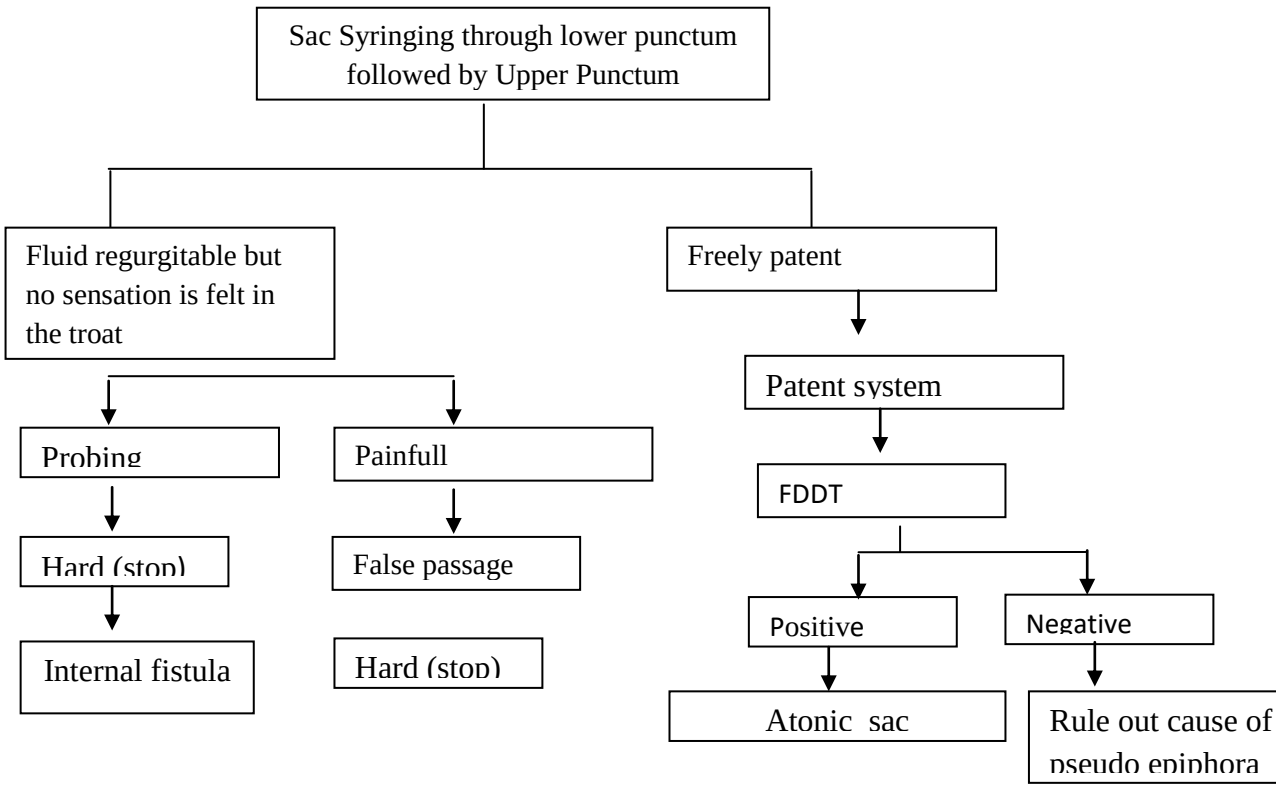
doshaja

- **Vimarga gamana** – There is change in the gati of the ashru in ashruvaha srotas is the vimarga gamana. Any change in the normal flow and gati of ashru in Ashruvah srotas is called as Vimargagamana of Ashruvaha srotas. The vimargagamana of ashruvaha srotas can be of two types. It can occur by the block in the nasolacrimal, canalicular duct and by vimargagamana of the tear flow from the abnormal track due to conditions such as Fistula of nasolacrimal duct. It can be understood as 'Swamanaawasthanachuti" of the ashru.It can occur as apravrutti or atipravrutti while in modern aspect tear contains three chemicals those are lipid, water and mucus and variation in its percentage in tear would be referred as Swamanatchuti of Ashruvah srotas.

Line of treatment of Ashruvaha srotas is similar to the line of treatment of Rasvaha and udakavaha srotodushti. Treatment mentioned by acharya sushruta in kriyakalpa adhyaya of uttartantra is also the treatment for Ashruvaha srotodushti.

Flow chart 1: Interpretation of the Clinical Anatomical Entities In Srava of Ashruvaha Srotas By Sac Syringing




Sac Syringing through lower punctum followed by Upper Punctum
Fluid regurgitable but no sensation is felt in the troat
Freely patent
Probing
Painfull
Patent system
Hard (stop)
False passage
FDDT
Internal fistula
Hard (stop)
Positive
Negative
Atonic sac
Rule out cause of pseudo epiphora

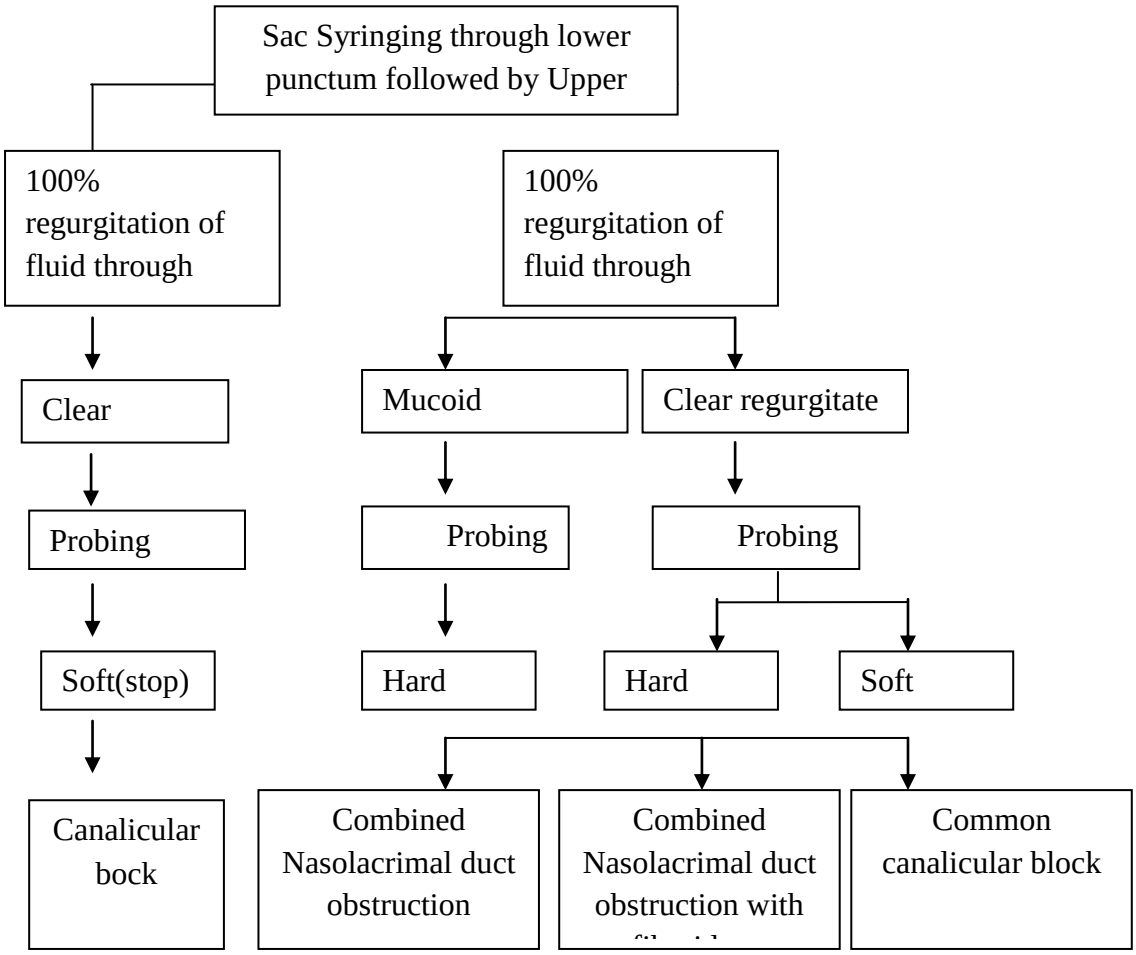

Sac Syringing through lower punctum followed by Upper
100% regurgitation of fluid through
100% regurgitation of fluid through
Clear
Mucoid
Clear regurgitate
Probing
Probing
Probing
Soft(stop)
Hard
Hard
Soft
Canalicular bock
Combined Nasolacrimal duct obstruction
Combined Nasolacrimal duct obstruction with
Common canalicular block

Table no 37: Interpretation of Ashruvaha strotas and its Anatomical Structures based on Clinical observational study

Pathology	Anatomical Entities	Presenting Features	No of Cases
Atipravrutti of Ashruvaha srotas	Lacrimal gland hypersecreation. Anatomical (obstructive) due to Punctal abnormatilies Canalicular abnormatlities. Lacrimal Sac, Nasolacrimal duct obstruction.	Increased secretion Hypersecretion Thin Watery secretion Mucopurulant,Purulant	Punctal abnormalities-60 Lacrimal punctum-52 Lacrimal sac abnormalities - 63 Canalicular/Naso lacrimal duct -33
Sanga and Aapravrutti	Naso lacrimal duct involved Complete block Partial lock	Odema and Thin Watery secretion Mucopurulant,purulant DNS(deviated nasal septum) Analysed by diagnostic probing Dry eye Analysed by Dry Eye, Schimers test	Complete block-64 Partial -36 Dry eye- 8 Deficiency of mucin -2
Siranam granthi	Lacrimal sac and lacrimal duct	Vesicals,Cyst ,tumours Fistula	Vesicals-4 Fistul-2 Tumours-1
Vimarga gamana	Nasolacrimal duct And its regurgitation	Regurgitation on probing & Analysed by Type of Regurgitant material ,ROPLAS	Type of Regurgitant –clear-21,mucopurulant-70 Purulant-9 ROPLAS-Clear/Mucoid/Mucopurulant-98, No regurgitation -2

CONTRIBUTION TO SCIENCE AND SOCIETY -outcome of the study

This study was carried out to bring clarity with respect to the Ashruvaha srotas and related to its anatomical limitations and disease pertaining to this srotas. With the help of parameters available in Ayurveda classics and modern science, an effort is made to define the structural entities of Ashruvaha srotas by carrying out both cadaveric and observational study in the patients suffering from srava disorder of the netra.

Contribution of cadaveric study to academics and Clinicians

In the following headings the contribution to Academics and Clinicians can be ascertained.

A. **Concept of Anukta Srotas–** Understanding for Academicians and for further research.

B. Vyapti of Ashruvaha srotas- This contributes for the diagnosis and treatment of Ashruvaha sroto vikara i.e especially Srava Vyadhi for Clinicians**.**

C. Srotodusti of Ashruvaha Srotas.

A. **Concept of Anukta**

Our acharyas have mentioned the information in the form of key words and they expect that their followers should find the exact meaning of those words, so to study and establish concepts which are not explained sufficiently they used the term anukta they have tried to mention the concept in a presided manner.With the help of Pramanas we can study anukta srotas.

The Anukta is the technical term used in Tantrayukti- Atidesha tantrayukti. Chakrapani comments that Atidesha tantayukti helps for clarification of hidden meaning and derives the unsaid things. This anukta is useful to understand the ayurvedic concepts as well as to understand and incorporate new concepts from contemporary science. Hence the integrative approach in this study contributes lot to science and society.

After reviewing all the classics, Anukta srotas are to be studied because acharyas stated srotas are innumerable, due to emerging disease related Ashru and its related structures. The disease related to Ashruvaha srotas are increasing due to drastic change in lifestyle along with Ahara and viharaja nidana, new emerging pathogens.

B. **Vyapti of Ashruvaha srotas**

This concept contributes for the diagnosis and treatment of Ashruvaha sroto vikara i.e especially Srava Vyadhi for Clinicians. Even though anatomical limitation of Asrhuvaha srotas has not been mentioned in detail but on the basis of dissection carried and Anatomical landmarks like Maxillary line, M-point and axilla are the three important landmarks help to determine the location and extension of Ashruvahasrotas.

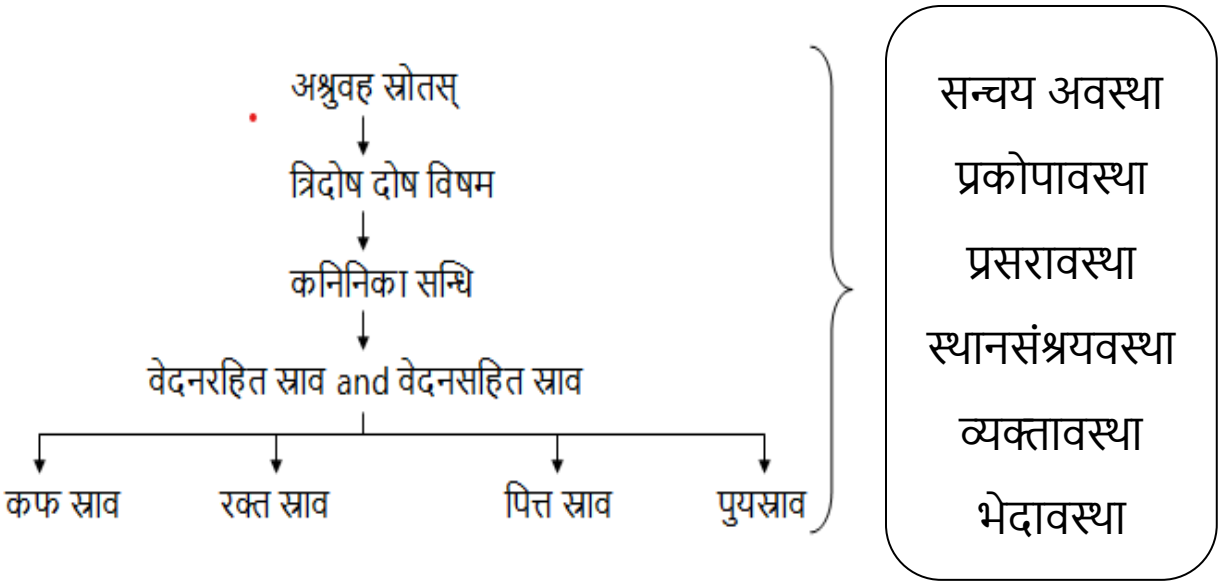
1. M Point –defines and helps to clinicians to exposure the Ashruvaha srotas clearly in dushana of lacrimal sac area. It is to be used as an inferior limit of surgical exposure of lacrimal sac.
2. Maxillary line – Helps the Shalya and Shalakaya tantra clinicians in terms of endo DCR procedures. Therefore, an incision performed anterior to maxillary line could be sufficient to expose lacrimal sac too.
3. In Asian patients, the frontal process of the maxilla is very thick compared to other studies. Surgical drills may be required for the Asian patient to expose the upper portion of the sac fossa

C. **Srotodusti of Ashruvaha Srotas.**

Ashruvaha srotodushti hetus, they are of two types. 1) Specific hetus. 2) General Hetus.

1. Specific hetus: Bashpavegadharana, ati-shoka, ati-rodana and manasika vikaras etc.
2. General hetus:Ama, Adhyashana, Vishamashana, Anashana, Trushnajwara etc.

It's Samprapthi and Samprapthi Vighatana is highlighted in this study, and this can be implemented by the Academicians and clinicians for the study of Ashruvaha sroto dustivikara and vyadhi and plan for the Clinicians to implement appropriate line of treatment at various stages of Srava vyadhi of Ashruvaha srotas. *Samprapthi vighatana meva chikitsa* like this,



The srava vyadhi when in Prasaravashtha due to Vyana vayu Prakopa shows following features,

- Atipravrutti- Excessive secretions
- Sanga- Due to Picchila, abhishandhi and tantumat swabhava may stick to ashruvaha sroto marga and slow down ashru circulation initially and later there is manifestation of Srotorodha (obstruction).

This helps for the academicians and clinicians to study the ashruvaha sroto vikara and plan for treatment of it.

Possible line of treatment of Ashruvaha srotodushti

Ashruvaha sroto chikitsa treatment can be done in two modalities

a. Nidana parivarjana and Bhaishajya prayoga
b. Shastra karma -especially *Eshana karma* (probing and sac syringing)

a) Nidana parivarjana and Bhaishajya prayoga

- Nidanaparivarjan is the first line of treatment to treat ashruvaha srotodushti vikara. Clinicians should advice the Nidana Parivarjana as first line of treatment followed by Line of treatment of Ashruvaha srotadusti which is similar to the line of treatment of Rasavaha and udakavaha srotodushti.
- From the present study it can be ascertained that the Atipravrutti and Sanga are commonly seen pathology and in recent era the use of technologies such as mobiles, computers, habit of watching television,

increase in pollution, more use of air condition , contribute to the nidana of Ashruvaha stoto vyadhi.

- While describing the chikitsa of Bashpavegavarodha, acharya has mentioned the "*swapnamadyapriyakatha*" as the treatment for sanga of Ashruvah srotas, in other words as the above mentioned symptoms are directly related with manas, therefore by treating the manas one can correct the ashruvaha srotodushti.
- The Ashruvaha srotas is situated adjacent to netra, hence all treatment adopted for treating Netra vyadhis mentioned by Sushrutacharya in kriyakalpa adhyaya of uttartantra can be used to treat Ashruvaha srotas.
- Application of Rasanjana leads to srava of ashruvaha srotas which causes shodhana of netra and all netragata srotas. Hence, applying anjana to the eye is also one of the treatments.

b) Shastra karma -especially *Eshana karma* (probing and sac syringing)

- This can be done when there is sanga (obstruction) which is usually felt as resistance at 3mm or more.

CONCLUSION

Cadaveric Study

- The landmarks of clinical importance are noted such as maxillary line, M point, axilla. These formed the base for the interpretation of structures related to Ashruvahasrotas.
- The structures of Ashruvahasrotus includes,
    - Ashru utpatti – Ashru Granthi (Lacrimal gland)
    - Ashrumarga (Storage and drainage system)- Ashruprapika (Lacrimal canialiculi, Ashrujavanika (Tear film), Ashrudwara (lacrimal puncta), Ashrukumbika (Lacrimal sac) Ashrukulya/Netra nadi (Nasolacrimal duct)

Clinical observational study

- Mulasthana of Ashruvaha srotus can be defined on two aspects,
    - on the basis of srotomula –Ashrugranthi (Lacrimal Gland)
    - on the basis of sroto dusti –Lacrimal sac and Nasolacrimal duct
- Clinical study reveals that vata and pittapradhana prakruti, females of low economic status are more prone for sraava vyadhi. The type of srava predominantly seen in this study Puyasrava (Mucopurulant).
- Thus, from this study it can be concluded that the Anatomical structures of Clinical significance (with respect to pathology) are,
    - Atipravrutti- Lacrimal gland (Ashrugranthi), Punctum (Ashrudwarasanjnaya)
    - Sanga – Nasolacrimal Duct and Punctum
    - Siranam Granthi – Lacrimal Sac+ Duct
    - Vimarga Gamana – Nasolacrimal Duct

Hence hypothesis, H_1**:** Structures related to Ashruvaha Srotas can be defined by Cadaveric and Clinical observational study is accepted.

SUMMARY

The thesis entitled **"A Comprehensive Study on Ashruvaha Sroto Shareera with Special Reference to Srava"** comprises of chapters namely,

Chapter 1- introduction

General idea regarding the Srotas, Ashrivaha srotas, and srava description has been covered in the introduction part along with need for the study in the present scenario is been highlighted.

Chapter 2 - Aims and Objectives

Aim to study on Ashruvaha Sroto Shareera with Special Reference to Srava. Objectives of the study are,

1. To compile and carryout the conceptual study of Ashruvaha Sroto Shareera along with Netra shareera.
2. To conduct Eye dissection on five cadavers and to determine the structures related to Ashruvaha Srotas.
3. To conduct clinical observational study on cases having Netra srava

Chapter 3- Research Question and Hypothesis

Research Question - Is it possible to define terms related to Ashruvaha Srotas by the Cadaveric and clinical observational study?. With the Hypothesis,

H_1**:** Structures related to Ashruvaha Srotas can be defined by Cadaveric study and Clinical observational study

H_0**:** Structures related to Ashruvaha Srotas cannot be defined by Cadaveric study and Clinical observational study

Chapter 4- Previous Work Done

- Previous work done was studied in detail

Chapter 5- Review of literature

Review of literature is subdivided into Ayurvedic review and modern review, Charaka tried to describe the Srotas right from the subject level where as Sushruta described their gross structural aspect. Acharya Sushruta presented the Srotas in gross or macro form, as he was Surgeon; he presented his findings observed during dissection. If a close observation is made regarding the description of Srotas, we find the difference between Charaka views with Sushruta. Charaka being a physician, most

of the preference is bringing allocated to biological aspect of the body and Sushruta gave more importance to surgical aspect. The condition of Charaka in this regard helps the physician to understand the Rachana of Srotas to a greater extent and their role in the causation of the disease.

Another structure associated with transmigration of Ashru is the Ashrumarga referred in the description of 'Srava rogas'. Ashrumargas are derived from akasha mahabhoota which is having space similarly as lacrimal passage. Ashrumarga are situated in kaneenaka sandhi. As regards their working, it is clear from their anatomic location and description of function that these are concerned with the drainage of Ashru.

Chapter 6- Material and Method

Methodology for Cadaveric Dissection

- Method of sampling: Convenient sampling method
- Sample size: 5
- Part: Cadaver's head

Sections: Sagittally sectioned specimens. Preserved in10% formaldehyde solution

A case proforma was prepared for dissection point of view as per Cunnigham manual and methodology from recent research works was adopted and observations were noted. Based on observations the structures related to Ashruvaha Srotas were defined.

Clinical Observational study

- Method of sampling: Convenient sampling method
- Sample size: 100 cases of Netra srava

A detailed history was taken in each case, followed by thorough general and systemic examination and ocular examination as per the proforma attached subsequently.

After analysing study an effort was made to correlate and reconstruct the various terminologies with the parts of ashruvaha srotas.

Chapter 7-Analysis and Interpretation

Application of Trividha Pramana for Interpretation of Ashruvaha Srotas entities.

- Pratyakshyapramana
- Anumanapramana
- Aptopadeshapramana

Interpretation of Ashruvaha Srotas entities and terms based on Clinical Perspective.

- Secretory part - Secretes tear

- Distributive – Spreads all over eye and maintain the moisture
- Excretory part – excess fluid excrete through nose, removes toxic material also.

By observing pathology related to srotas the terms can be stated as follows,

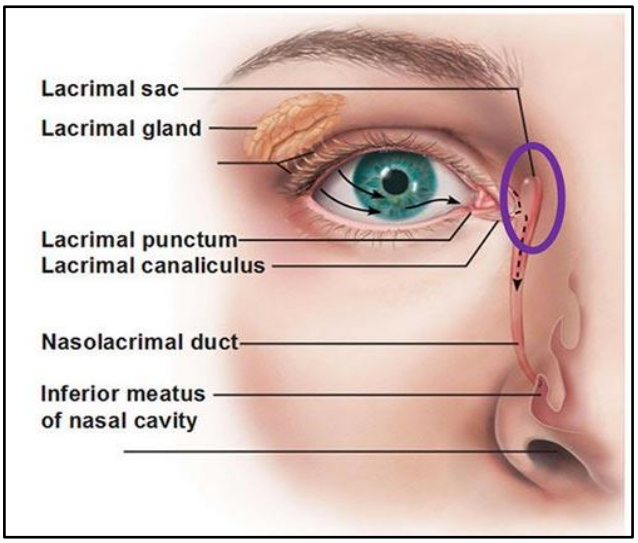
- Mula stanana / Prabhava sthana/ Utpatti stana
- Vyapti of stotus /Ashrumarga
- Srotodushti related

Chapter 8- Contribution to Science and Society

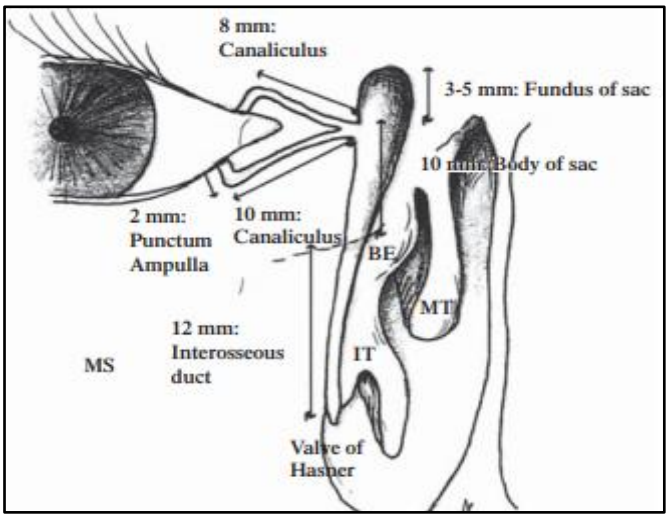
An effort is made to define the structural entities of Ashruvaha srotas by carrying out both cadaveric and observational study in the patients suffering from srava disorder of the netra which helps Academician and Clinicians in growth of science and society.

Chapter 9- Conclusion

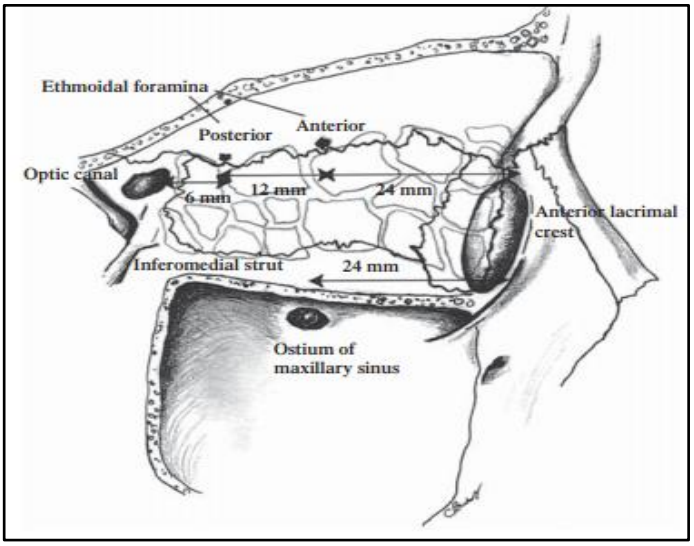
- Cadaveric Study- The landmarks of clinical importance are defined as
    - Ashru utpatti – Ashru Granthi (Lacrimal gland)
    - Ashrumarga (Storage and drainage system)- Ashruprapika (Lacrimal canialiculi, Ashrujavanika (Tear film), Ashrudwara (lacrimal puncta), Ashrukumbika (Lacrimal sac) Ashrukulya (Nasolacrimal duct)
- Clinical observational study-from this study it can be concluded that the Anatomical structures of Clinical significance (with respect to pathology) are,
    - Atipravrutti- Lacrimal gland (Ashrugranthi), Punctum (Ashrudwara)
    - Sanga – Nasolacrimal Duct, Punctum
    - Siranam Granthi – Lacrimal Sac+ Duct
    - Vimarga Gamana – Nasolacrimal Duct



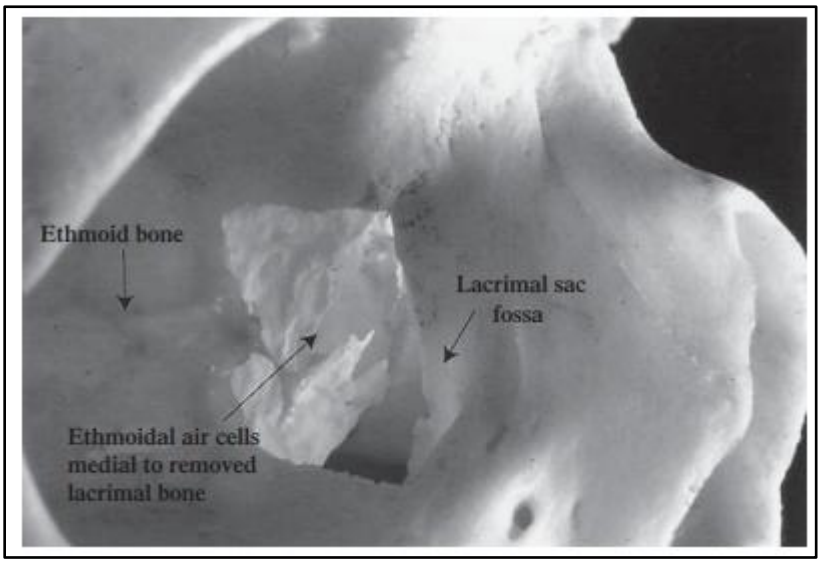
Pic No 1: Anatomy of Lacrimal apparatus



Pic No 2: Schematic diagram showing various distance of excretory system of tears



Pic No 3: Schematic diagram showing various distances in lateral wall of nose



Pic No 4: Boney orbit showing lacrimal sac area.

Pic no5: Dissection photograph of Orbicularis oculi muscle after removing skin and facia showing Orbital part and Palpebral part

Pic no 6 : Dissection photograph of Superior lacrimal papilla and Superior lacrimal punctum

Pic no 7: Dissection photograph of inferiorlacrimalpapilla and punctum

Pic no 8:Syringing of superior lacrimal papilla

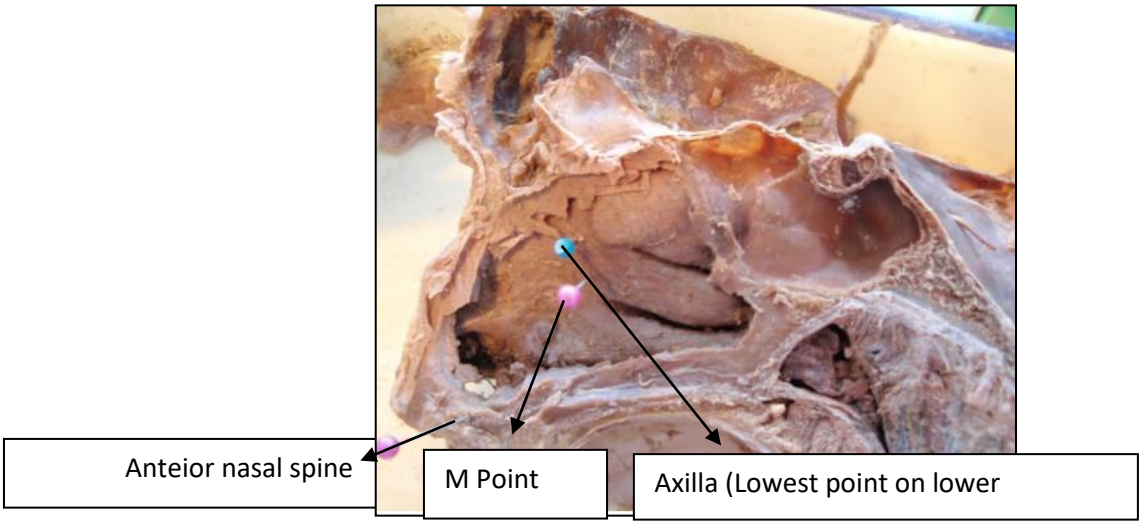
Pic no 9 : Holding of Lacrimal gland

Pic no 10: Dissection photograph of Medial palpebral ligament

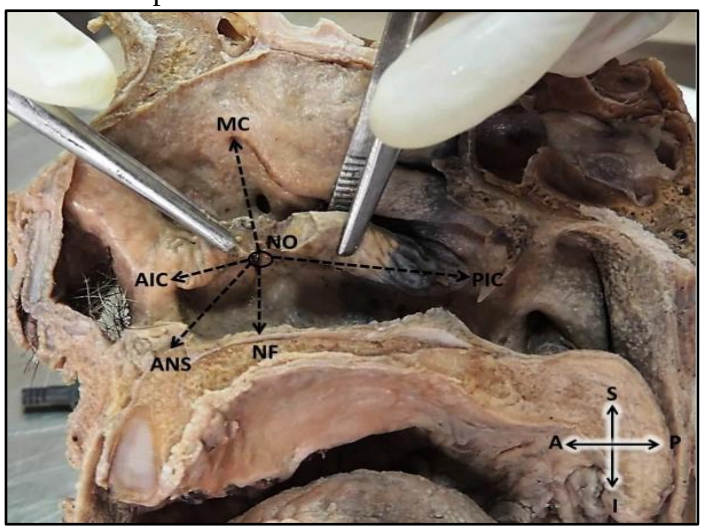
Pic No 11: Sagittal section of lateral wall of nose

Pic no12:Dissection photo showing Length of lacrimal sac in arrow

Pic No 13 : Dissection photo showing Length of Nasolacrimal duct

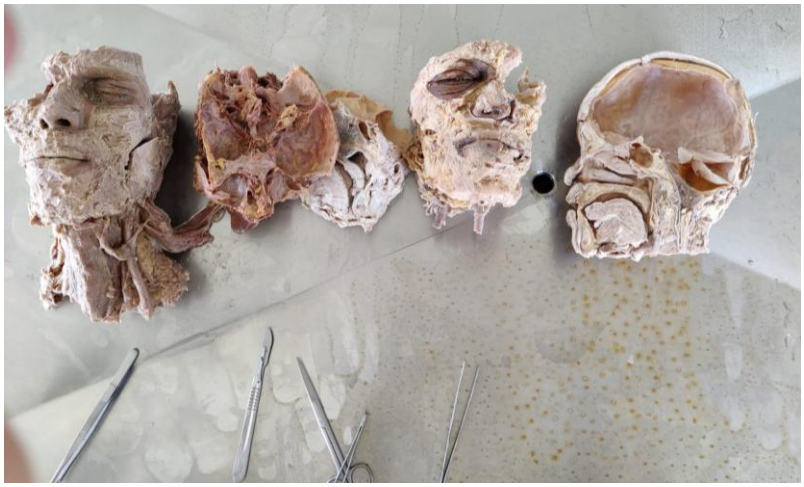


Pic No 14 :Important landmark in dissection



Pic No 15: Sagittal section of nasal cavity showing anatomical landmarks used and distances measured NO- nasolacrimal duct orifice, ANS- anterior nasal spine, NF- floor of the nasal cavity, AIC- anterior end of inferior concha, PIC- posterior end of inferior concha, MC- anterior end of middle conch

Pic No 16: Dissecting in the region of Lacrimal sac area



Pic No17: Specimens used in the cadaveric dissection

Pic No 18 : Research scholar in dissection procedures.

Pic No 19: Clinical observational study – Eye examination

Pic No 20: Clinical observational study – Probing in lacrimal puncta.

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ANNEXURE I

PROFORMA FOR LIST OF SCREENED PARTICIPANTS

Tilak Maharastra Vidyapeeth, Pune

Title: A COMPREHENSIVE STUDY ON ASHRUVAHA SROTO SHAREERA WITH SPECIAL REFERENCE TO SRAVA

PhD Scholar: Vd.Gururaj D Jahagirdar **Guide: Vd. Atul Mankar**

Screening Sl No.	Name of Patient (screened)	Included or excluded?	Subject Enrolment No.	Sign

ANNEXURE II

PROFORMA OF SCREENING FORM

Tilak Maharastra Vidyapeeth, Pune

Title: A COMPREHENSIVE STUDY ON ASHRUVAHA SROTO SHAREERA WITH SPECIAL REFERENCE TO SRAVA

PhD Scholar: Vd.Gururaj D Jahagirdar **Guide: Vd. Atul Mankar**

(Enter a √ in the appropriate box)

1. OPD No:_____ **2.**Screening Subject Sl. No.: _____

3. Name of the Subject: _____

4. Gender: Male(1) Female(2)

5. Age: _____years

6.

Address:_____

_____

_

7. Telephone No: _____

8. Diagnosis and Inclusion Criteria

Sl no	**Inclusion Criteria**	Yes	No
1.			
2.			
3.			
4.			

9. Criteria for Exclusion

	Criteria for Exclusion	Yes	No
1.			
2.			
3.			
4.			
5.			
6.			

Remark: Whether patient /participant is suitable for enrollment into study? Yes / No

If enrolled: - Subject Enrollment No.:

Sign of Scholar Sign of Guide (with date)

ANNEXURE III
PATIENT INFORMATION SHEET

1. Study Title: A COMPREHENSIVE STUDY ON ASHRUVAHA SROTO SHAREERA WITH SPECIAL REFERENCE TO SRAVA

2. Invitation:

You are being invited to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve, please take time to read the following information carefully and discuss it with parent(s) / guardian(s) if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

3. What is the purpose of study?

Present work is a Clinicoanatomical study; here we will define the structures involved in ashruvaha srotas with the help of srava vyadhi. With the help of parameters available in Ayurveda classic and modern science, an effort will be made to define the structural entities of Ashruvaha srotas by carrying out both cadaveric and observational study in the patients suffering from srava disorder of the netra. So to update the knowledge in modern era, study of this Ashruvaha Srotas in correlation of those on modern parameter is need of the hour.

4. Do I have to take part?

It is up to you to decide whether to take part or not. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a consent form later. If you agree to take part, you are still free to withdraw at any time even without giving any reason. This will not affect the standard of care you receive.

5. What will happen to me if I take part?

If you agree to take part in this study, you will be subjected to your history and data Collection.

6. What do I have to do?

You have to adhere to the instructions given to you by your Investigating physician regarding the History and data collection. During the course of observational study, you can safely continue with your regular medication (for which you need to intimate your investigating physician) and the only word of caution is that you should follow

and obey the instructions of your investigator very religiously while continuing with the survey.

7. What is the drug or procedure that is being tested?

N/A

8. What are the expected side effects / risks of the treatment?

N/A

9. What are the possible benefits of taking part?

Would help the academician to define the ashruvaha sroto Shareera. Will help the Physician to understand about the Ashruvaha srotas for the diagnosis, pathogenesis and treatment

10. What if new information becomes available?

N/A

11. What happens when the research study stops?

You can continue with the advice given by your physician.

12. What if something goes wrong?

N/A

13. Will my taking part in this study be kept confidential?

Yes, all your information will be kept confidential. But, any of your medical records may be inspected by the concerned authority for the purpose of analyzing the results. They may also be looked at by members of Institutional Ethics Committee and by Regulatory authorities / Court to check that the study is being carried out correctly. Your name, however, will not be made public and any sensitive matter regarding your state of health will be kept confidential.

14. What will happen to the results of the research study?

The results of the observational study will be published in leading medical journals so that other doctors and researchers can benefit from the results. You can ask your investigating physician for a copy of the publication.

15. Contact for further information:

If desirous of any relevant information at any stage of the observational study, you may feel free to ask your investigating physician for that information.

Dr.Gururaj D Jahagirdar, Contact Number - +919663367292

You would be given a copy of the information sheet and a signed consent form.

ANNEXURE IV

CONSENT FORM

1. **Title of synopsis: A COMPREHENSIVE STUDY ON ASHRUVAHA SROTO SHAREERA WITH SPECIAL REFERENCE TO SRAVA**

2. Participant enrollment ID for this trial: _____

3. Name of the Investigating Physician (Research Scholar):Dr. Gururaj D Jahagirdar

4. Name of the Guide: Dr.Atul Mankar, M.D. (Ayu) Ph.d

5. I confirm that I have read/the study has been explained to me adequately and I have understood the information sheet for the above study and had the opportunity to ask questions.

6. I hope to complete the study, but I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason, and without my medical care or legal rights being affected.

7. I understand that my doctor will provide information about my progress, in confidence, to the related authorities. I understand that the information held by the Investigators and researchers and records maintained by the concerned authorities might be used to follow up my health status.

8. I understand that the information will be used for OBSERVATIONAL study only and that I will not be identified in any way in the analysis and reporting of the results. I understand that sections of any of my medical notes may be looked at by the authorities or responsible individuals from the members of the IEC, Regulatory authorities or Court, if necessary. I give permission for these individuals to have access to my records.

Signature of the Subject:

Name of the Subject : **Date:**

Signature of the Witness:

Name of the Witness : **Date:**

Signature of the Research Scholar:

Name of the Research Scholar: Dr.Gururaj D Jahagirdar **Date:**

Signature of the Guide:

Name of the Guide: Dr.Atul Mankar, M.D. (Ayu) Ph.d **Date:**

ANNEXURE V
Tilak Maharastra Vidyapeeth, Pune
CASE PROFORMA

TITLE: A COMPREHENSIVE STUDY ON ASHRUVAHA SROTO SHAREERA WITH SPECIAL REFERENCE TO SRAVA

Case no: _____ Date:
Name: _____Age:___
OPD/IPD No:__
Gender: Male/Female
Religion: Hindu/Muslim/Christian/Others ( )
Occupation: Education:
Address:_____

Phone No:_____
Socioeconomic status: Diagnosis:

CHIEF COMPLAINTS WITH DURATION: OD/OS/OU

Sl no	**Subjective Parameters**		**Duration**
1.	Colour o f Srava/Discharge	White/Yellow/Red	
2.	Nature of Srava/Discharge	Thin watery/Purulent /thick/slimy/Blood mixed	
3.	Quantity of Srava/ Discharge	Mild /Moderate/Profuse	
4.	**Gradings**	**Grade 1** : Intermittent clear discharge, not causing functional problems to the patient **Grade 2:** Continuous clear discharge, not causing functional problems to the patient. **Grade 3:** Continuous and copious clear discharge, causing blurred vision and/or skin excoraiation and /or requiring constant wiping. **Grade 4:** Mucoid or mucopurulant discharge.	

FAMILY HISTORY (including age of onset) Present /Absent

SURGICAL HISTORY

- Related to eye: Absent/Present
  - If present specify,_____
- Any other: Absent/Present
  - If present specify,_____

PERSONAL HISTORY

Habits: Tobacco/Alcohol/Pan Chewing/others (if so, specify_____)

SYSTEMIC EXAMINATION

ENT Examination –

- **Associated nasal Pathology**

PRAKRUTI PAREEKSHA- Vata pradhana/Pitta pradhana/Kapha pradhana - (……)

OCULAR EXAMINATION

Visual Acuity Examination

PARAMETER	RIGHT	LEFTEYE(OS)	BOTHEYES(OU)
	Snellen's Reading	Snellen's Reading	Snellen's Reading
VA for Distance			
Pinhole improvement			
VA for Near			

EXTERNAL OCULAR EXAMINATION (Normal/Abnormal)

- **Head Posture**
  - Normal /Abnormal (Tilted horizontally/Tilted vertically)
- **Forehead**
  - Normal Wrinkles/Increased wrinkles/Decreased wrinkles
- **Eyebrows**
  - Level of both eye brows: Normal/Unequal level
  - Cilia: Normal in number /Madarosis

Other Structures

PARAMETER	R.Eye	Left.Ey
Eye lids ***Skin over eyelid*** • Colour–(Normal /Hyper-pigmented/Hypo-pigmented) • Oedema–(Absent/Diffuse/Localized) • Vesicles–(Present/Absent)		
Position • Normal /Ptosis/Lid retraction ***Movement*** • Follows eyeball /Does not follow eyeball ***Lid Margin*** 1. Ectropion-(Present/Absent) 2. Entropion-(Present/Absent) • Scales-(Present/Absent) • Thickening-(Present/Absent) • Stye/Chalazion-(Present/Absent)		

Lacrimal Apparatus • Position of punctum (Normal/ Abnormal) • Approximate size of punctum- Normal/Narrow • Lacrimal sac area–(Normal /Abnormal {Redness/swelling) • Lacrimal puncta–(Normal /Abnormal{eversion/stenosis}) **Functional variation Grading :** **Grade 1:** Narrow Punctum ,but easily dilatable **Grade 2 :** Narrow Punctum ,not easily dilatable **Grade 3 :** Closed punctum with shallow punctual papilla **Grade 4 :** Closed punctum with flat punctual papilla **Evaluation of Tear Film:** • Schirmer's Test I - (normal range – 10-30 mm in 5min) • Tear break –up time (normal range - 15-30seconds) • **ROPLAS (Regurgitation Test**–Positive/Negative) ➢ If Positive – Watery ,mucoid, mucopurulent, bloodstained • **Sac syringing – Complete/partial** • **Diagnostic probing** a. Resistance at 3mm from Punctum - proximal Canalicular obstruction b. Resistance at 3-8 mm from Punctum – Mid Canalicular obstruction c. Resistance at beyond 8mm –Distal		
Other Criteria ***Conjunctiva*** • Papillae–(Present/Absent) • Follicles–(Present/Absent) • Concretion –(Present/Absent) • Congestion–(Present/Absent) • Chemosis–(Present/Absent) • Pterygium–(Present/Absent)		
Sclera • Congestion–(Present/Absent) • Discolouration–(Present/Absent) • Inflammation –(Present/Absent) • Bulge/Staphyloma–(Present/Absent)		

Cornea • Size–(Micro/Macro/Normal) • Shape–(Normal /Cone Shaped/Globe Shaped/Plano) • Transparency 1. Corneal Oedema–(Present/Absent) 2. Others–Vascularisation/Scars/ Pannus/Opacity–(Present/Absent) 3. Arcussenilis(Present/Absent)		
Anterior Chamber • Depth–(Normal /Shallow/Deep) • Contents–(WateryFluid/others)		
Iris • Colour–(Light brown/Dark Brown/Lightblue /Light Green) • Synechiae-(Present/Absent) • Pattern - (Normal /Atrophy present)		
Pupil • Shape–(Normal /Dilated/Semi-dilated/Constricted) • Colour–(Greyish black/jet black/grayish white/pearly		
Pupillary Reaction • Direct–(Normal /Sluggish/Absent) • Consensual–(Normal /Sluggish/Absent)		
Lens • Nature–(Phakic/Aphakia/Pseudophakia) • Position –(Normal /Dislocation/Subluxation • Shape(Biconvex/Lenticonus) • Colour–(faint blue/grayish white/pearly white/black) • Transparency (Transparent/Opacification present) 1. Type of Opacity(Cortical/Nuclear /PSC/Others) 2. (Grade0/Grade1/Grade2/Grade3/Grade4)		
IOP		
FUNDUS EXAMINATION		
Media		
Optic Disc		
Blood Vessels		
Macula		

Signature of the Candidate **Signature of the Guide**

Patient consent for medical photography

Patient name: Date:

I consent for medical photographs to be made of me. I understand that the information may be used in my medical records, for the purpose of dissertation study or journals or for publication in medical textbooks and my identity will not be revealed as I have designated below. By consenting to these medical photographs I understand that I will not receive payment from any party. Refusal to consent to photographs will no way affect the medical care I will receive. If any questions or wish to withdraw my consent in future I may contact:……

By signing this from below I confirm that this consent has been explained to me in terms which I understand

1. I consent for these photographs to be in medical publications, including medical journal, textbooks and electronic publications. I understand that the images may seen by members of general public, in addition to scientist, medical researchers that regularly use these publications in their professional education. These photographs will be used without identification such as by name and address. I also agree for my image to be shown for teaching purposes and to be used for my medical record.

   …… (Signature
   …….. (Witness)

   (Signature of the patient) (Witness)

ANNEXURE VI

OBSERVATION PROFORMA OF CADAVERIC DISSECTION

"A COMPREHENSIVE STUDY ON ASHRUVAHA SROTO SHAREERA WITH SPECIAL REFERENCE TO SRAVA"

Name of the PhD Scholar	Name of the guide
Dr Gururaj D Jahagirdar	Dr Atul Mankar

1. Cadaver number: MALE/FEMALE

2. Date of commencement of dissection:

3. Objective of the study:

4. Procedure of dissection:

5. Observations:

6. Results based on observations:

Signature of the Scholar Signature of the guide

ANNEXURE VII--CODES USED IN MASTER CHART

Particulars	Code	Description
Gender	1	Male
	2	Female
occupation	1	Housewife
	2	Work
Socio economic status	1	Low
	2	Middle
	3	High
Laterality	1	OS
	2	OD
	3	OU
Presenting complaint	1	Epiphora
	2	Epiphora + Swelling
	3	Epiphora + Discharge
	4	Epiphora + Swelling +Discharge
Colour of srava/discharge	1	White
	2	Yellow
	3	Red
Nature of srava/discharge	1	Thin watery
	2	Purulent/thick
	3	Blood mixed
Quantity of srava	1	Mild
	2	Moderate
	3	Profuse
Grading of discharge	1	Intermittent clear discharge, not causing functional problems to the patient
	2	Continuous clear discharge, not causing functional problems to the patient.
	3	Continuous and copious clear discharge, causing blurred vision and/or skin excoraiation and /or requiring constant wiping.
	4	Mucoid or mucopurulant discharge.
Asso. nasal pathology	0	Nil
	1	DNS
	2	Swollen turbinate
	3	Nasal polyp
	4	Any other
Prakruti pareeksha	1	Vata pradhana
	2	Pitta pradhana
	3	Kapha pradhana
Visual acuity	1	6/6
	2	6/9
	3	6/12
	4	6/15
	5	6/18
	6	6/21
	7	6/24
Ext. ocular examination	1	Normal
	2	Abnormal
Eye lids skin	1	Normal

over eyelid	2	Hyperpigmented
	3	Hypopigmented
odema	1	Absent
	2	Diffuse
	3	Localized
vesicles	0	Present
	1	Absent
Position of eye lid	1	Normal
	2	Ptosis
	3	Lid retraction
Movement of eyelid	1	Follows eyeball
	2	Does not follow eyeball
Lid margin	1	Normal
	2	Abnormal
Position of punctum	1	Normal
	2	Abnormal
Approx. size of punctum	1	Normal
	2	Abnormal
Lacrimal sac area	1	Normal
	2	Abnormal
Lacrimal puncta	1	Normal
	2	Abnormal
Functional variation Grading	1	Narrow Punctum ,but easily dilatable
	2	Narrow Punctum ,not easily dilatable
	3	Closed punctum with shallow punctual papilla
	4	Closed punctum with flat punctual papilla
schirmertest1	1	Normal
	2	Hypersecretion
	3	Dry eye
Tear breakuptime	1	Normal(more than10mm)
	2	Deficiency of mucin
Block in sac syringing test	1	Complete
	2	Partial
Regurgitant on sac syringing	1	Watery/clear
	2	Mucoid
	3	Mucopurulent
	4	bloodstained
ROPLAS	1	clear mucoid/MP
	2	BT
	3	No regurgitation but sac empties
	4	No regurgitation but sac does not empty
Diagnostic probing	1	Resistance at 3mm from Punctum -proximal Canalicular obstruction
	2	Resistance at 3-8 mm from Punctum – Mid Canalicular obstruction
	3	Resistance at beyond 8mm –Distal Canalicular obstruction
Other criteria	1	No other relative symptoms
	2	Other relative symptoms present

Annexure VII- Clinical observation study

case no	Age	Gender	Occupation	Socioeconomic status	Laterality	Presenting complaint	Colour of srava/discharge	Nature of srava/dischage	Quantity of srava	Gradings of discharge	Associated nasal pathology	Prakruti pareeksha	Visual acuity	External ocular examination	Eye lids- skin over eyelid	odema	Vesicles	Position of eye lid	Movement of eye lid	Lidmargin	Position of punctum	Approx size of punctum	Lacrimal sac area	Lacrimal puncta	Functional variation grading	Schirmertest1	Tear breakuptime	Block in sac syringing test	Regurgitant on sac syringing	ROPLAS	Diagnostic probing	Other criteria
1	43	2	1	2	2	1	2	2	3	4	1	2	1	1	1	1	0	1	1	0	1	2	2	1	1	1	1	1	2	1	1	0
2	36	1	2	1	2	4	2	2	2	4	0	1	2	1	1	1	0	1	1	0	1	2	1	2	1	1	1	1	2	1	1	0
3	54	2	2	2	2	4	1	2	3	4	0	2	2	1	1	1	0	1	1	0	1	2	2	1	2	1	1	1	2	1	2	0
4	34	2	1	2	2	4	2	2	2	4	0	1	1	1	1	1	0	1	1	0	1	2	1	2	2	1	1	1	2	1	1	0
5	41	1	2	1	1	3	2	2	1	4	1	2	1	1	1	1	0	1	1	0	1	2	2	2	2	2	1	1	2	1	2	0
6	52	2	1	1	3	2	1	3	2	4	0	2	3	1	1	1	0	1	1	0	1	1	2	1	1	1	1	2	2	1	2	0
7	35	2	2	2	3	3	2	2	2	2	0	3	2	1	1	1	0	1	1	0	1	1	2	1	1	3	2	2	1	1	1	0
8	40	2	1	2	1	2	1	1	2	1	1	1	1	1	1	1	0	1	1	0	1	1	2	1	2	2	2	2	1	1	2	0
9	28	2	1	2	2	3	1	1	2	1	1	3	1	1	1	1	0	1	1	0	1	1	2	1	1	2	2	2	1	1	1	0
10	46	2	1	1	1	4	2	2	2	4	1	2	3	1	1	1	0	1	1	0	1	2	2	2	2	2	1	1	2	1	1	0
11	52	2	1	2	2	4	2	2	2	4	0	1	1	1	1	1	0	1	1	0	1	2	1	2	2	1	1	1	2	1	1	0
12	39	1	2	1	1	3	2	2	1	4	1	2	1	1	1	1	0	1	1	0	1	2	2	2	2	2	1	1	2	1	2	0
13	58	2	1	2	2	4	1	2	3	4	0	2	3	1	1	1	0	1	1	0	1	2	2	1	2	1	1	1	2	1	2	0
14	29	2	1	2	2	1	1	1	1	2	1	1	1	1	1	1	0	1	1	0	1	1	1	1	2	1	1	1	2	1	2	0
15	27	2	1	1	2	1	1	2	2	4	0	1	1	1	1	1	0	1	1	0	1	2	2	1	2	1	1	1	2	1	1	0
16	60	2	1	2	2	4	1	2	3	4	0	2	3	1	1	1	0	1	1	0	1	2	2	1	2	1	1	1	2	1	2	0
17	53	1	2	2	1	4	2	2	2	4	1	2	2	1	1	1	0	1	1	0	1	2	2	2	2	2	1	1	2	1	2	0
18	39	1	2	1	2	4	2	2	2	4	0	1	1	1	1	1	0	1	1	0	1	2	1	2	1	1	1	1	2	1	1	0
19	48	2	2	2	1	2	1	1	2	1	1	1	2	1	1	1	0	1	1	0	1	1	2	1	2	3	2	1	2	1	1	0
20	48	2	1	2	2	1	2	2	3	4	1	2	1	1	1	1	0	1	1	0	1	2	2	1	1	1	1	1	2	1	1	0

case no	Age	Gender	Occupation	Socioeconomic status	Laterality	Presenting complaint	Colour of srava/discharge	Nature of srava/dischage	Quantity of srava	Gradings of discharge	Associated nasal pathology	Prakruti pareeksha	Visual acuity	External ocular examination	Eye lids- skin over eyelid	odema	Vesicles	Position of eye lid	Movement of eye lid	Lidmargin	Position of punctum	Approx size of punctum	Lacrimal sac area	Lacrimal puncta	Functional variation grading	Schirmertest1	Tear breakuptime	Block in sac syringing test	Regurgitant on sac syringing	ROPLAS	Diagnostic probing	Other criteria
21	32	1	2	1	2	1	1	1	2	2	0	1	1	1	1	1	0	1	1	0	1	1	2	1	1	1	1	2	1	1	1	0
22	56	1	2	1	2	4	2	2	2	4	0	1	5	1	1	1	0	1	1	0	1	2	1	2	1	1	1	1	2	1	1	0
23	33	2	2	2	1	2	1	1	2	1	0	1	2	1	1	1	0	1	1	0	1	1	1	1	1	2	2	2	1	1	1	0
24	44	2	2	1	3	2	1	3	2	4	0	2	3	1	1	1	0	1	1	0	1	1	2	1	1	1	1	2	2	1	2	0
25	26	1	2	1	1	1	2	2	2	4	0	2	1	1	1	1	0	1	1	0	1	2	1	2	2	1	1	1	2	1	2	0
26	36	2	2	2	1	1	2	2	1	4	1	2	1	1	1	1	0	1	1	0	1	2	1	2	2	1	1	1	2	1	2	0
27	35	2	2	2	3	3	2	2	1	2	0	2	1	1	1	1	0	1	1	0	1	2	2	2	2	2	1	1	2	1	2	0
28	51	2	2	2	2	4	1	2	3	4	0	2	3	1	1	1	0	1	1	0	1	2	2	1	2	1	1	1	2	1	2	0
29	40	1	2	1	2	4	2	2	2	4	0	1	1	1	1	1	0	1	1	0	1	2	1	2	1	1	1	1	2	1	1	0
30	45	2	1	1	1	4	2	2	2	4	1	3	1	1	1	1	0	1	1	0	1	2	2	2	2	2	1	1	2	1	1	0
31	27	2	1	1	2	4	1	2	2	4	0	1	1	1	1	1	0	1	1	0	1	2	2	2	1	2	2	2	2	1	2	0
32	38	1	2	1	2	4	2	2	2	4	0	1	1	1	1	1	0	1	1	0	1	2	1	2	1	1	1	1	2	1	1	0
33	37	2	2	2	3	4	2	2	2	2	0	3	1	1	1	1	0	1	1	0	1	1	1	2	1	1	1	2	3	1	2	0
34	60	2	1	2	2	1	1	1	1	2	1	1	3	1	1	1	0	1	1	0	1	1	1	1	2	1	1	1	2	1	2	0
35	38	2	1	1	2	3	2	2	2	4	0	1	1	1	1	1	0	1	1	0	1	1	2	1	1	1	1	2	2	1	2	0
36	27	2	1	2	2	3	1	1	2	1	1	3	1	1	1	1	0	1	1	0	1	1	2	1	1	2	1	2	1	1	1	0
37	55	2	2	2	2	4	1	2	3	4	1	3	2	1	1	1	0	1	1	0	1	2	2	1	2	1	1	1	2	1	2	0
38	41	2	1	2	1	2	1	1	2	1	1	1	1	1	1	1	1	1	1	0	1	1	2	1	2	2	1	2	1	1	2	0
39	28	2	1	1	2	1	1	2	2	4	0	1	1	1	1	1	0	1	1	0	1	2	2	1	2	2	1	1	2	1	1	0
40	39	1	2	1	2	4	2	2	2	4	0	1	1	1	1	1	0	1	1	0	1	2	1	2	1	1	1	1	2	1	2	0
41	46	2	1	1	2	4	1	1	2	1	0	1	3	1	1	1	0	1	1	0	1	1	2	2	2	2	1	2	1	1	1	0

case no	Age	Gender	Occupation	Socioeconomic status	Laterality	Presenting complaint	Colour of srava/discharge	Nature of srava/dischage	Quantity of srava	Gradings of discharge	Associated nasal pathology	Prakruti pareeksha	Visual acuity	External ocular examination	Eye lids- skin over eyelid	odema	Vesicles	Position of eye lid	Movement of eye lid	Lidmargin	Position of punctum	Approx size of punctum	Lacrimal sac area	Lacrimal puncta	Functional variation grading	Schirmertest1	Tear breakuptime	Block in sac syringing test	Regurgitant on sac syringing	ROPLAS	Diagnostic probing	Other criteria
42	40	1	2	1	2	1	1	1	2	2	1	3	2	1	1	1	0	1	1	0	1	1	1	2	1	1	1	2	3	1	2	0
43	52	1	2	1	1	4	2	2	2	2	0	1	2	1	1	1	0	1	1	0	1	2	1	2	2	1	1	1	2	1	1	0
44	45	2	1	1	2	2	1	1	2	1	0	2	1	1	1	1	0	1	1	0	1	1	1	1	1	2	1	2	1	1	1	0
45	29	2	1	2	2	3	1	1	2	1	1	3	1	1	1	1	0	1	1	0	1	1	2	1	1	3	2	2	1	1	1	0
46	53	1	2	2	1	4	2	2	2	4	1	2	3	1	1	1	0	1	1	0	1	2	2	2	2	3	1	1	2	1	2	0
47	49	2	2	1	2	1	2	2	3	4	1	2	1	1	1	1	0	1	1	0	1	2	2	1	2	1	1	1	2	1	1	0
48	51	2	1	2	2	4	2	2	2	4	0	1	1	1	1	0	0	1	1	0	1	2	1	2	2	1	1	1	2	1	1	0
49	33	2	2	2	1	2	1	1	2	1	0	1	1	1	1	1	0	1	1	0	1	1	2	1	1	2	1	2	1	1	2	0
50	38	2	2	1	1	2	2	2	2	4	1	1	1	1	1	1	0	1	1	0	1	1	2	1	1	1	1	2	2	1	2	0
51	37	2	2	2	3	4	2	2	2	2	0	3	1	1	1	1	0	1	1	0	1	1	1	2	1	1	1	2	3	1	2	0
52	41	2	1	2	1	2	1	1	2	1	1	1	1	1	1	1	0	1	1	1	1	1	2	1	2	2	1	1	1	1	2	0
53	50	1	2	1	1	3	2	2	1	4	1	2	2	1	1	1	0	1	1	1	2	2	2	2	2	2	1	1	2	1	2	0
54	30	1	2	1	2	1	1	1	2	2	0	1	1	1	1	1	0	1	1	0	1	1	2	1	1	1	1	2	1	1	1	0
55	53	1	2	1	3	4	2	2	2	4	1	2	3	1	1	1	0	1	1	0	1	2	2	2	1	2	1	1	2	1	1	0
56	43	2	1	2	1	1	2	2	3	4	1	2	1	1	1	1	1	1	1	0	1	2	2	1	1	1	1	1	2	1	1	0
57	35	2	2	2	3	3	2	2	2	2	0	3	1	1	1	1	0	1	1	0	1	1	2	1	1	3	2	2	1	1	1	0
58	42	1	2	1	2	4	2	2	2	4	0	1	1	1	1	1	0	1	1	0	1	2	1	2	1	1	1	1	2	1	1	0
59	39	2	1	2	3	4	2	2	2	2	0	3	1	1	1	1	0	1	1	0	1	1	1	2	1	1	1	2	3	1	2	0
60	26	1	2	1	1	1	2	2	2	3	0	2	1	1	1	1	0	1	1	0	1	2	1	2	2	1	1	1	2	1	2	0
61	40	1	2	1	2	4	2	2	2	2	0	1	1	1	1	1	0	1	1	0	1	2	1	2	1	1	1	1	2	1	1	0
62	48	2	1	2	2	2	2	2	2	4	0	2	1	1	1	1	0	1	1	0	1	2	2	1	1	1	1	1	2	1	1	0

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63	29	2	2	1	2	2	2	2	2	4	0	1	1	1	1	0	1	1	1	1	1	1	2	1	1	1	1	2	2	1	2	0
64	60	2	2	2	2	4	1	2	3	4	0	2	4	1	1	1	0	1	1	0	1	2	2	1	2	1	1	1	2	1	2	0
65	35	2	1	2	3	4	2	2	2	2	0	3	1	1	1	1	0	1	1	0	1	1	1	2	1	1	1	2	3	1	2	0
66	52	1	2	2	1	4	2	2	2	4	0	2	1	1	1	1	0	1	1	0	1	2	2	2	2	3	1	1	2	1	2	0
67	46	2	1	1	2	2	1	1	2	1	0	1	1	1	1	1	0	1	1	0	1	1	2	1	1	3	2	2	1	1	1	0
68	32	2	1	2	1	3	2	2	1	4	0	2	1	1	1	1	0	1	1	0	1	2	2	2	2	2	1	1	2	1	2	0
69	22	1	2	1	1	3	2	2	2	4	0	2	1	1	1	1	0	1	1	0	1	2	2	2	2	2	1	1	2	1	2	0
70	48	2	2	1	2	2	2	2	3	4	1	2	1	1	1	1	0	1	1	0	1	2	2	1	2	1	1	1	2	1	1	0
71	49	2	1	1	1	4	2	2	2	4	0	3	1	1	1	1	0	1	1	0	1	2	2	2	2	2	1	1	2	1	1	0
72	37	2	2	2	3	4	2	2	2	2	0	2	1	1	1	1	0	1	1	0	1	1	1	2	1	1	1	2	2	1	2	0
73	36	2	1	2	2	4	2	2	2	4	0	2	1	1	1	1	0	1	1	1	1	2	1	2	2	1	1	1	2	1	1	0
74	53	2	1	2	2	4	2	2	2	4	0	1	1	1	1	1	0	1	1	0	1	2	1	2	2	1	1	1	2	1	1	0
75	58	2	1	2	1	4	2	2	2	4	1	2	1	1	1	1	0	1	1	0	1	2	2	2	2	1	1	2	3	3	2	0
76	51	1	2	1	2	1	1	1	2	2	0	3	1	1	1	1	0	1	1	0	1	1	1	2	1	1	1	2	3	1	2	0
77	46	2	1	1	1	3	3	1	1	1	2	1	1	1	1	1	0	1	1	1	2	2	2	2	2	2	1	1	2	1	2	0
78	45	2	1	2	1	2	1	1	2	1	0	1	1	1	1	1	0	1	1	0	1	1	2	1	2	2	1	2	1	1	2	0
79	36	1	2	1	2	4	2	2	2	4	0	1	1	1	1	1	0	1	1	0	1	2	1	2	1	1	1	1	2	1	1	0
80	54	1	2	1	3	4	2	2	2	4	1	2	3	1	1	1	0	1	1	0	1	2	2	2	1	2	1	1	2	1	1	0
81	62	2	1	2	1	4	2	2	2	4	0	2	3	1	1	1	0	1	1	0	1	2	1	2	1	1	1	1	2	1	1	0
82	29	2	2	1	2	2	1	1	2	1	1	1	1	1	1	1	0	1	1	0	1	1	2	1	2	2	2	2	1	1	2	0
83	54	1	2	1	2	4	2	2	2	4	1	2	3	1	1	1	0	1	1	0	1	2	2	2	2	1	1	2	3	3	2	0

case no	Age	Gender	Occupation	Socioeconomic status	Laterality	Presenting complaint	Colour of srava/discharge	Nature of srava/dischage	Quantity of srava	Gradings of discharge	Associated nasal pathology	Prakruti pareeksha	Visual acuity	External ocular examination	Eye lids- skin over eyelid	odema	Vesicles	Position of eye lid	Movement of eye lid	Lidmargin	Position of punctum	Approx size of punctum	Lacrimal sac area	Lacrimal puncta	Functional variation grading	Schirmertest1	Tear breakuptime	Block in sac syringing test	Regurgitant on sac syringing	ROPLAS	Diagnostic probing	Other criteria
84	52	2	1	2	1	4	2	2	2	4	0	1	1	1	1	1	0	1	1	0	1	2	1	2	2	2	1	1	2	1	2	0
85	38	2	2	2	2	3	1	1	2	1	0	3	1	1	1	1	0	1	1	0	1	1	2	1	1	3	2	1	1	1	1	0
86	46	2	2	2	1	3	2	2	1	4	1	2	1	1	1	1	0	1	1	0	1	2	2	2	2	2	1	1	2	1	2	0
87	43	2	2	1	2	2	1	1	2	1	1	1	1	1	1	1	0	1	1	0	1	1	2	1	2	2	1	2	1	1	2	0
88	59	1	2	1	2	4	2	2	2	4	0	1	3	1	1	1	0	1	1	0	1	2	1	2	1	1	1	1	2	1	1	0
89	33	2	1	1	2	1	1	2	2	4	0	1	1	1	1	1	0	1	1	0	1	2	2	1	2	2	1	1	2	1	1	0
90	49	2	1	2	1	2	1	1	2	1	0	1	1	1	1	1	0	1	1	0	1	1	2	1	2	2	1	2	1	1	2	0
91	36	2	2	2	3	4	2	2	2	2	0	3	1	1	1	1	0	1	1	0	1	1	1	2	1	1	1	2	3	1	2	0
92	31	1	2	1	2	1	1	1	2	2	0	1	3	1	1	1	0	1	1	0	1	1	2	1	1	1	1	2	1	1	1	0
93	46	2	1	1	3	2	1	3	2	4	0	2	1	1	1	1	0	1	1	0	1	1	2	1	1	1	1	2	2	1	2	0
94	53	2	1	2	2	4	2	2	2	4	0	1	1	1	1	1	0	1	1	0	1	2	1	2	1	1	1	1	2	1	1	0
95	48	1	2	1	2	1	1	1	1	2	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	2	1	1	0
96	29	2	1	1	1	1	1	2	2	4	0	1	1	1	1	1	0	1	1	0	1	1	1	1	2	1	1	1	2	1	2	0
97	49	2	1	1	1	3	2	2	3	4	0	2	1	1	1	1	0	1	1	0	1	2	2	1	2	2	1	1	2	1	1	0
98	56	1	2	2	1	3	2	2	2	4	1	2	2	1	1	1	1	1	1	0	1	2	2	1	2	1	1	1	2	1	1	0
99	39	1	2	1	2	4	2	2	2	4	0	1	3	1	1	1	0	1	1	0	1	2	2	2	2	2	1	1	2	1	2	0
100	51	2	2	2	2	4	1	2	3	4	0	2	3	1	1	1	0	1	1	0	1	2	1	2	2	1	1	1	2	1	1	0

Anexure VIII- Master chart for Cadaver study

cadevermo	Maxillary line - Clear (right)	Maxillary line clear (left)	Length of maxillay line right	Length o fmaxillay line left	Anterior nasal spine to M point (right)	Anterior nasal spine to M point (left)	Relation of lacromomaxillarysuture line to maxilaryline (right)	Relation of lacromomaxillarysuture line to maxilaryline (left)	Thickness of lacrimal bone (right)	Thickness of lacrimal bone (left)	Lacrimal sac seen (right)	Lacrimal sac seen (left)	Position of superior end of sac (right)	Position of superior end of sac (left)	Length of lacrimalsac (right)	Length of lacrimalsac (left)	Relation between lacrimal sac and maxillary line (right)	Relation between lacrimal sac and maxillary line (left)	Relation of anterior point of middle turbinate to nasolacrimal duct (right)	Relation of anterior point of middle turbinate to nasolacrimal duct (left)	Lenght of nasolacrimal duct (right)	Lenght of nasolacrimal duct (left)
1	no	yes	12.52	12.36	29.76	30.11	anterior	anterior	0.25	0.25	less than half	less than half	above axilla	above axilla	11.86	12.17	less than half	less than half	at	at	9.90	10.53
2	yes	yes	12.16	12.30	29.71	29.89	posterior	posterior	0.24	0.25	less than half	less than half	below	below	11.27	12.07	more than half	more than half	anterior	anterior	9.96	10.21
3	yes	yes	12.09	11.99	30.26	30.09	posterior	anterior	0.26	0.25	more than half	more than half	above axilla	above axilla	11.89	11.99	more than half	more than half	posterior	posterior	9.86	10.10
4	yes	no	13.01	12.98	29.82	30.01	posterior	over	0.24	0.24	more than half	more than half	below	below	11.86	12.15	more than half	more than half	posterior	posterior	9.93	10.41
5	yes	yes	12.82	12.40	29.28	29.23	over	anterior	0.23	0.24	less than half	less than half	above axilla	above axilla	11.64	12.20	less than half	less than half	posterior	posterior	9.86	10.26

ANNEXURE X- IEC LETTER

Institutional Ethics Committee
SHRI DHARMASTHALA MANJUNATHESHWARA INSTITUTE OF AYURVEDA & HOSPITAL, BANGALORE
Anchepalya, Kumbalgodu Post, Mysore Road, Bengaluru -560074, Karnataka, India
Phone: 080-28437560 email ID: sdmcabh@gmail.com

Chairman: **Prof. Jagadeesh K**
Professor & Principal, SDMIA&H, Bengaluru

Member Secretary
Dr. Reshmi Pushpan
Associate Professor, SDMIA&H, Bengaluru

Members
Dr. Ravishankar B
Pharmacologist & Director SDMCRA&A, Udupi

Dr Yaligar MY
In-House Faculty & Professor SDMIA&H, Bengaluru

Dr. Shivprasad Chiplunkar
In-House Faculty & Professor SDMIA&H, Bengaluru

Dr. Prasanna Kumar Bhat
Expert- Paedodontist, Rajarajeshwari Dental College, Bengaluru

Mr. Sujith Subhash
Expert- Microbiologist, AVP Research Foundation, Bangalore

Mr. Manjunathiah
Social Worker, Bangalore

Mr. K M Mahesh Babu
Legal Expert, Bangalore

COMMUNICATION OF DECISION OF INSTITUTIONAL ETHICS COMMITTEE (IEC)

IEC No: SDMIA/IEC/03/2016-2017

Protocol Title: A COMPREHENSIVE STUDY ON ASHRUVAHA SROTO SHAREERA WITH SPECIAL REFERENCE TO SRAVA

Principal Investigator: DR GURURAJ D JAHAGIRDAR

Designation and Address : ASSOCIATE PROFESSOR, DEPARTMENT OF SHAREERA RACHANA, SHRI DHARMASTHALA MANJUNATHESHWARA INSTITUTE OF AYURVEDA & HOSPITAL, ANCHEPALYA, KUMBALGODU POST, BENGALURU - 560074, KARNATAKA, INDIA

[√] New Review [ ] Revised Review

[ ] Expedited Review

Date of Review (D/M/Y): 20-07-2016

Date of previous review, if revised application:

Decision of the IEC:

[√] Recommended [ ] Recommended with suggestions

[ ] Revision [ ] Rejected

Suggestions/ Reasons/ Remarks: NONE

Recommended for a period of : 2 YEARS

Please note *
- Inform IEC immediately in case of any adverse events and serious adverse events.
- Inform IEC in case of any change of study procedure, site and investigator
- This permission is only for period mentioned above. Annual report to be submitted to IEC.
- Members of IEC have right to monitor the trial with prior intimation.

Dr Reshmi Pushpan

PRINCIPAL
SDM Institute of Ayurveda & Hospital
Anchepalya, Kumbalagodu Post
Bangalore-560074